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A New Species of *Doliocarpus* and a New Species of *Tetracera* (Dilleniaceae) from Brazil

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ABSTRACT. During the course of a taxonomic study of the Neotropical species of Dilleniaceae, two new species from Brazil were discovered: *Doliocarpus lombardii* from the "Mata Atlântica" and *Tetracera boomii* from the "Mata de Restringa" and "Cerrado" vegetation dominated by *Curatella americana* L. The two new species are described, illustrated, and compared to closely related species. By its sessile inflorescence *Doliocarpus lombardii* is closely related to *D. sessiliflorus* Martius, but differs from that species in its longer leaf blades (9–22 cm long), densely pubescent on the lower surface; sepals 5, 6–11 mm long, ovate or elliptic, adpressed sericeous in midrib internally; and fruit densely hispid. *Tetracera boomii* is known only from two places in Bahia and Sergipe states, Brazil, and is similar to *T. lasiocarpa* Eichler in that both bear follicles 1–1.5 cm long, densely hispid at the apex; however, *T. boomii* differs from that species in its leaves rigid-coriaceous, elliptic, aerolate below and margins dentate, inflorescences 1–2 cm long, bracteoles ca. 6 mm long, sepals 11–14, filaments 4–5 mm long, and aril completely covering the seed.

Key words: Brazil, Dilleniaceae, *Doliocarpus*, *Tetracera*.

Species of *Doliocarpus* Rolander are mostly lianas (rarely shrubs), with inflorescences that are ramiflorous, fasciculate, or glomerate, the ovary unicarpellate, 1-celled, the fruit a berry, and seeds covered with white arils. *Tetracera* L. is the only genus in the Dilleniaceae with either unisexual or bisexual flowers; all Neotropical species are androdioecious (Dickinson, 1968; Kubitzki, 1970). *Doliocarpus* includes about 45 species and *Tetracera* ca. 20; Brazil is the center of diversity for both genera.

Tetracera boomii G. Aymard C., sp. nov. TYPE: Brazil. Bahia: Entre Rios, 23 km from Subaúma on road to Entre Rios, 29 May 1981, *S. A. Mori & B. M. Boom 14196* (holotype, CEPEC not seen; isotype, NY). Figure 1.

Haec species *T. lasiocarpae* affinis, sed ab ea foliis rigido-coriaceis ellipticis subtus areolatis margine dentatis, inflorescentia 1–2 cm longa dense adpresso-pubescente; sepalis 11 ad 14, petalis 4 intus dense sericeis, filamentis 4–5 mm longis atque arillo semen omnino tegente.

Liana, bark brown, flaking; branches and branchlets sparsely adpressed pubescent to glabrescent when mature. Leaves elliptic, rigid-coriaceous, 4–22 × 3–13 cm, base cuneate, apex rotundate, scabrous and sparsely pilose on the upper surface, papillate and glabrescent on the lower surface, except for the midrib and secondary nerves, these sparsely adpressed pubescent, with stellate and simple trichomes, margins dentate mostly in the upper half, the veins elevated, areolate below, sunken above, with 6 to 15 parallel nerves on each side of mid-nerve, craspedodromous venation; petioles 0.5–2.2 cm long, 1–4 mm wide, subwinged, canaliculate, adpressed pubescent. Inflorescence thyrsoid, axillary or terminal, 1–2 cm long, rachis densely adpressed pubescent, bracteoles lanceolate, ca. 6 mm long, sparsely adpressed pubescent externally, sericeous internally mostly in the middle, pedicel 0.5–5 mm long, 1 to 3 flowers per

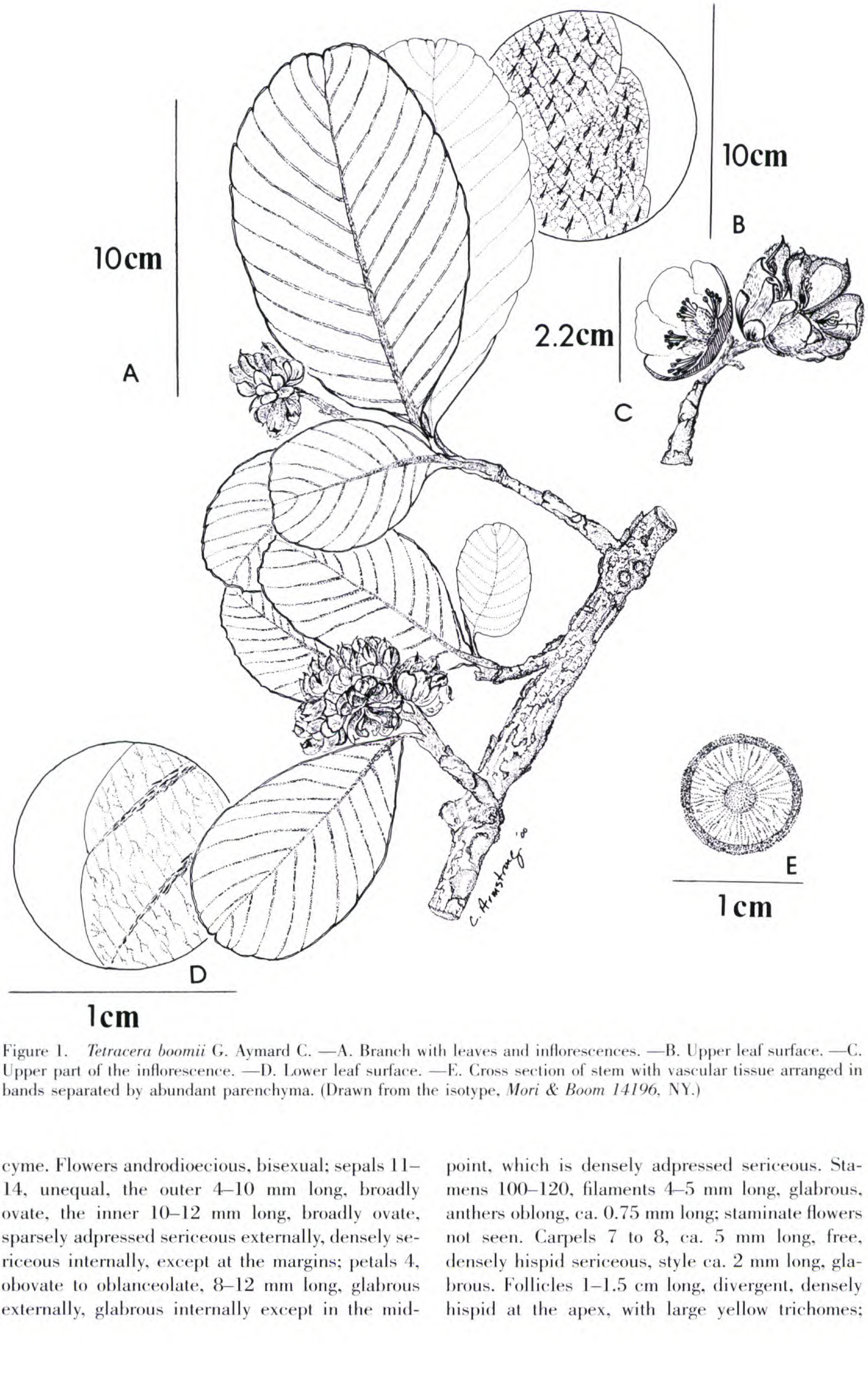

Figure 1. *Tetracera boomii* G. Aymard C. —A. Branch with leaves and inflorescences. —B. Upper leaf surface. —C. Upper part of the inflorescence. —D. Lower leaf surface. —E. Cross section of stem with vascular tissue arranged in bands separated by abundant parenchyma. (Drawn from the isotype, *Mori & Boom 14196*, NY.)

cyme. Flowers androdioecious, bisexual; sepals 11–14, unequal, the outer 4–10 mm long, broadly ovate, the inner 10–12 mm long, broadly ovate, sparsely adpressed sericeous externally, densely sericeous internally, except at the margins; petals 4, obovate to oblanceolate, 8–12 mm long, glabrous externally, glabrous internally except in the midpoint, which is densely adpressed sericeous. Stamens 100–120, filaments 4–5 mm long, glabrous, anthers oblong, ca. 0.75 mm long; staminate flowers not seen. Carpels 7 to 8, ca. 5 mm long, free, densely hispid sericeous, style ca. 2 mm long, glabrous. Follicles 1–1.5 cm long, divergent, densely hispid at the apex, with large yellow trichomes;

Table 1. Comparison of the distinguishing characters of *Tetracera boomii* and *T. lasiocarpa.*

	Tetracera boomii	*Tetracera lasiocarpa*
Leaves	rigid-coriaceous, elliptic, areolate below; margins dentate	subcoriaceous, obovate or elliptic, without areoles; margins mucronate-dentate
Inflorescence	1–2 cm long, densely adpressed pubescent; bracteoles ca. 6 mm long	5–10 cm long, strigose pubescent; bracteoles 2–4 mm long
Sepals	11–14	7–9
Petals	4, densely sericeous at midpoint internally	5, glabrous internally
Filaments	4–5 mm long	ca. 3 mm long
Aril	completely covering the seed	covering half the seed

style persistent, 1–2 mm long; seeds 1 per carpel, 4–5 mm long, black, aril laciniate, completely covering the seed.

Distribution and habitat. Tetracera boomii is known only from two collections, in "Mata da Restringa" and "Cerrado" areas dominated by *Curatella americana* in the Brazilian states of Bahia and Sergipe.

Because of its scabrous leaves and many-flowered cymes, *Tetracera boomii* belongs to the section *Tetracera* (Kubitzki, 1970). Based on the size of the follicles (1–1.5 cm long), which are densely hispid at the apex with large yellow trichomes, this new species is related to *T. lasiocarpa* from Bahia, Brazil. However, *T. boomii* can be distinguished from *T. lasiocarpa* by the characters indicated in Table 1.

This species is named in honor of Brian M. Boom, whose collections and fieldwork have added much to our knowledge of the Bahian flora.

Paratypes. BRAZIL. **Sergipe:** Santa Luzia do Itanhi, 500 m S of Distrito de Castro, 29 Nov. 1993, *S. C. de Sant'Ana et al. 480* (CEPEC, NY).

Doliocarpus lombardii G. Aymard C., sp. nov. TYPE: Brazil. Minas Gerais: Parque Estadual do Rio Doce, Marliéria-Salão Dourado, 15 June 1995, *J. A. Lombardi & L. G. Temponi 791* (holotype, BHCB; isotype, PORT). Figure 2.

Haec species *D. sessifloro* affinis, sed ab eo lamina foliari 9–22 cm longa 4–10 cm lata oblanceolata basi attenuata subtus dense pubescente, sepalis quinque 6–11 mm longis ovatis ellipticisve nervo medio interne adpresse sericeo atque fructu trichomatibus luteis dense hispido differt.

Liana, bark flaking; branches densely sericeous pubescent, becoming glabrescent when mature. Leaves oblanceolate, 9–22 × 4–10 cm, subcoriaceous, base attenuate, apex acuminate, margins subrevolute, strongly dentate, mostly in the upper half, becoming glabrous on the upper surface, except along the midrib and secondary nerves, where covered by adpressed trichomes, densely pubescent (erect trichomes) and verrucose on the lower surface, most dense along the midrib and secondary nerves; lateral nerves 11 to 16, convergent and linking 2 mm to the margin, elevated in the lower surface, petioles 6–8 mm, exalate, densely adpressed pubescent. Inflorescence sessile, axillary, sepals 5, 6–11 mm long, unequal (internally ovate, externally elliptic), densely adpressed sericeous externally, glabrous in the margins, adpressed sericeous in midrib internally, petals and stamens caducous, not seen; ovary densely hispid, style glabrous, 2–6 mm long. Fruit densely hispid sericeous, 0.6–1 cm diam.; seed black, 3–4 mm long, 2 per fruit, aril entire, completely covering the seed.

Distribution and habitat. Known only from the type and paratype collections, where it has been collected in "Mata Atlântica" forest in Minas Gerais state, Brazil.

Because of its tertiary venation and pubescent ovary, *Doliocarpus lombardii* belongs to the section *Doliocarpus* (Kubitzki, 1971). By it sessile inflorescence, this new species is most similar to *D. sessiliflorus* from Rio de Janeiro and São Paulo states, Brazil. However, *D. lombardii* differs from the latter species in its longer leaves, 9–22 × 4–10 cm, oblanceolate blades, attenuate base, densely pubescent in the lower surface; sepals 5, 6–11 mm long, ovate or elliptic, adpressed sericeous in midrib internally; and fruit densely hispid (trichomes yellow). In contrast, *D. sessiliflorus* has leaves 4–7 × 2–3 cm, obovate blades, cuneate base, sparsely pilose to glabrescent in the lower surface; sepals 5 or 6, ca. 5 mm long, suborbicular, glabrous internally; and fruit puberulent sericeous (gray trichomes).

This species is named in honor of Julio B. Lombardi, who collected the type specimen.

Paratypes. BRAZIL. **Minas Gerais:** Parque Estadual do Rio Doce, entrada do Parque, próximo Salão Dourado, Marliéria, 30 Mar. 1996, *J. A. Lombardi et al. 1188* (BHCB, PORT).

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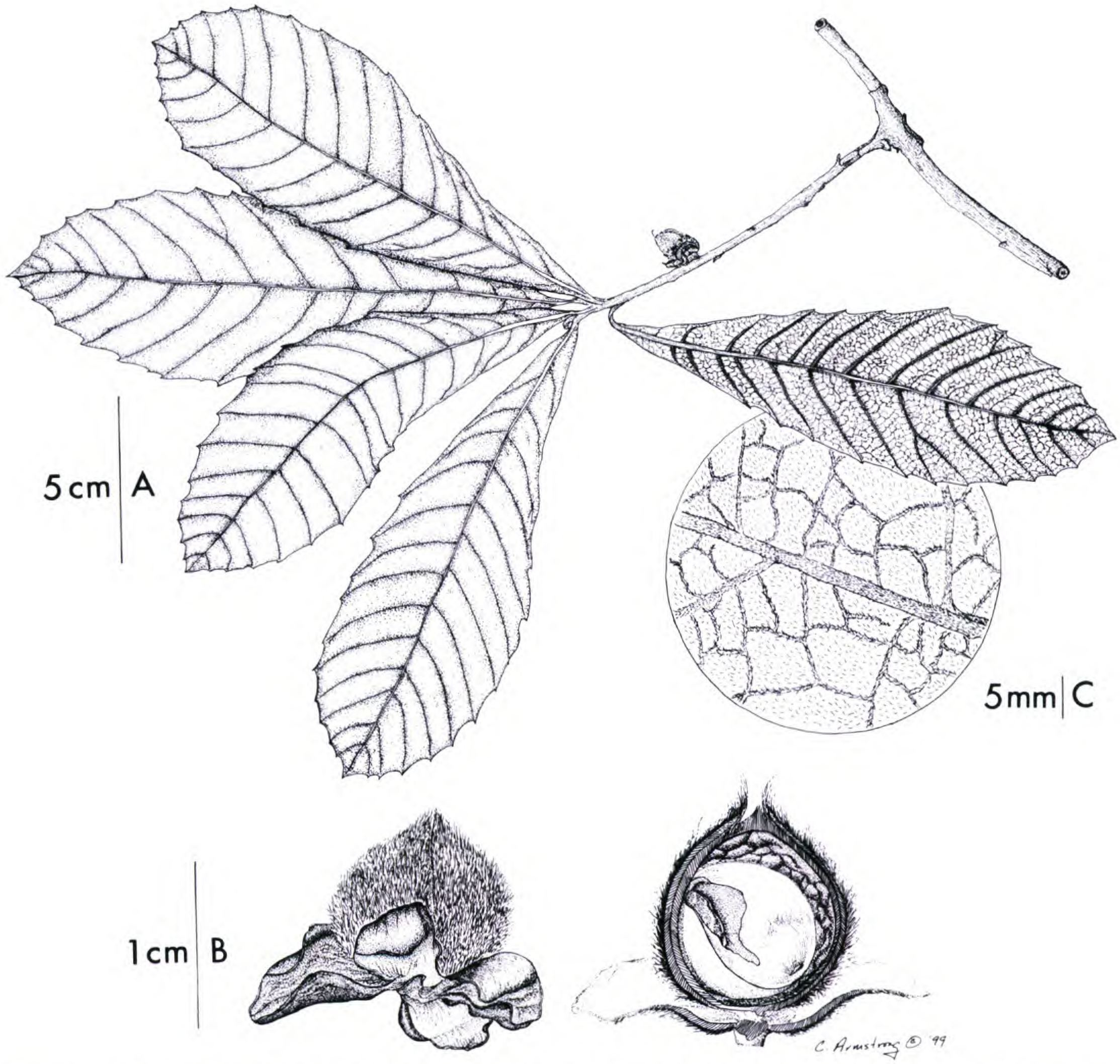

Figure 2. *Doliocarpus lombardii* G. Aymard C. —A. Branch with leaves and sessile inflorescence. —B. Flower with a young fruit, tissue removed showing the seed covered by the aril. —C. Lower leaf surface. (Drawn from the holotype, *Lombardi & Temponi 791*, BHCB.)

P. Delprete (NY) for their observations on the manuscript. I am grateful to J. B. Lombardi (HBCB) for sending the Dilleniaceae specimens to PORT, B. Manara (VEN) for revising the Latin descriptions, The New York Botanical Garden staff for making their facilities available for my research, and to Cynthia E. Armstrong for preparing the illustrations.

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Novitates Gabonenses 43: Four New Species of *Dichapetalum* (Dichapetalaceae) from Gabon

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ABSTRACT. *Dichapetalum berendinae*, *D. findouense*, *D. inaequale*, and *D. mathisii* (Dichapetalaceae) are described as new from Gabon. All four species are illustrated, and their distributions are mapped. The necessary adaptations of the keys, for the Central African species as well as for the *Flore du Gabon*, are provided.

RÉSUMÉ. *Dichapetalum berendinae*, *D. findouense*, *D. inaequale* et *D. mathisii* (Dichapetalaceae) du Gabon sont décrits et illustrés. Les cartes de répartition des quatre espèces sont présentées. Les adaptations nécessaires pour la clé des espèces centreafricaines de *Dichapetalum* ainsi que pour celle de la *Flore du Gabon* sont ajoutées.

Key words: *Dichapetalum*, Dichapetalaceae, Gabon.

The Dichapetalaceae are, with 58 species in two genera, very well represented in Gabon (Breteler, 1991). The family is characterized by simple, alternate, stipulate leaves, by axillary, cymose inflorescences whose peduncle may be adnate to the petiole, and, usually, by bilobed petals. In a paper dealing with Gabon's evergreen forests and its floristic richness (Breteler, 1990), it was suggested that more species would be discovered in further exploration. This expectation was based on the large number of known species that had been collected only once or a very few times. Since then two species, *Dichapetalum rabiense* Breteler (Breteler, 1993) and *Tapura arachnoidea* Breteler (Breteler, 1995), have been described. Four more *Dichapetalum* species are added now. The first fruits of *Dichapetalum berendinae* and *D. mathisii* were collected during "l'Opération Radeau des Cimes" held in Gabon in 1999. Here, collecting from the tree canopies was carried out from a sledge carried by a dirigible.

Dichapetalum berendinae Breteler, sp. nov. TYPE: Gabon. ± 70 km E of Lastoursville, E of Ndambi, 28 Nov. 1993 (fl), *F. J. & B. J. M. Breteler 12400* (holotype, WAG; isotypes, G, K, LBV, MA, MO, P, PRE, US). Figures 1, 5.

Dichapetalo heudelotii var. *heudelotii* affinis sed foliis majoribus crassioribusque, stipulis majoribus longe persistentibus, inflorescentiis longiramosis et fructibus plus minusve molliter cornutis differt.

Slender liana reaching the forest canopy or lianescent shrub. Branchlets brown-tomentellous, the same indumentum present on stipules, petioles, on the nervation of leaves beneath as well as on the inflorescence, ± persistent. Stipules ± persistent, narrowly triangular, (5–)8–12(–14) × 2–3 mm. Leaves: petiole semiterete to ± obtriangular in transverse section, usually grooved above, often laterally compressed, 3–6(–10) mm long; lamina firmly papery to (sub)coriaceous, bright green above, dull beneath, obovate-elliptic, rarely ovate, (1.5–)2(–2.5) times as long as wide, (12–)14–25(–46) × (6–)7–13(–21) cm, usually obliquely cordate at base or rarely rounded, acuminate (to apiculate) at apex, the acumen 0.5–1.5 cm long, often reflexed, densely hairy, and distinctly glandular beneath; tomentellous both sides when young, soon glabrescent above except for the impressed midrib, the 10 to 16 pairs of secondary nerves usually soon glabrescent as well, beneath distinctly prominent reticulate nerves with a more persistent tomentellous indumentum especially so on the midrib and the secondary nerves; glands present on lower surface only, very distinct, convex, concentrated near leaf base and near apex as well as on the acumen, a few glands dispersed over the lower surface as well. Inflorescence many flowered, 3–4 times distinctly branched, usually distinctly pedunculate, peduncle (0–)1–3.5(–5.5) cm long, tomentellous; bracts and bracteoles concave, ovate-triangular, 2–3 mm long. Pedicel (1–)2–3 mm long, densely appressed-puberulous-tomentellous. Sepals firm, ± erect to (partly) spreading, ± free or shortly united at base, elliptic to ovate-triangular, 2.5–3.5 × 1–1.5 mm, ± acute at apex, outside hairy as pedicel, glabrous or appressed-puberulous on apical part inside. Petals erect or slightly curved inward, free at base, narrowly obovate in outline, 3–4 mm long, bilobed, glabrous except for a very few hairs below sinus outside; lobes 1.5 mm long, concave, ± acute to

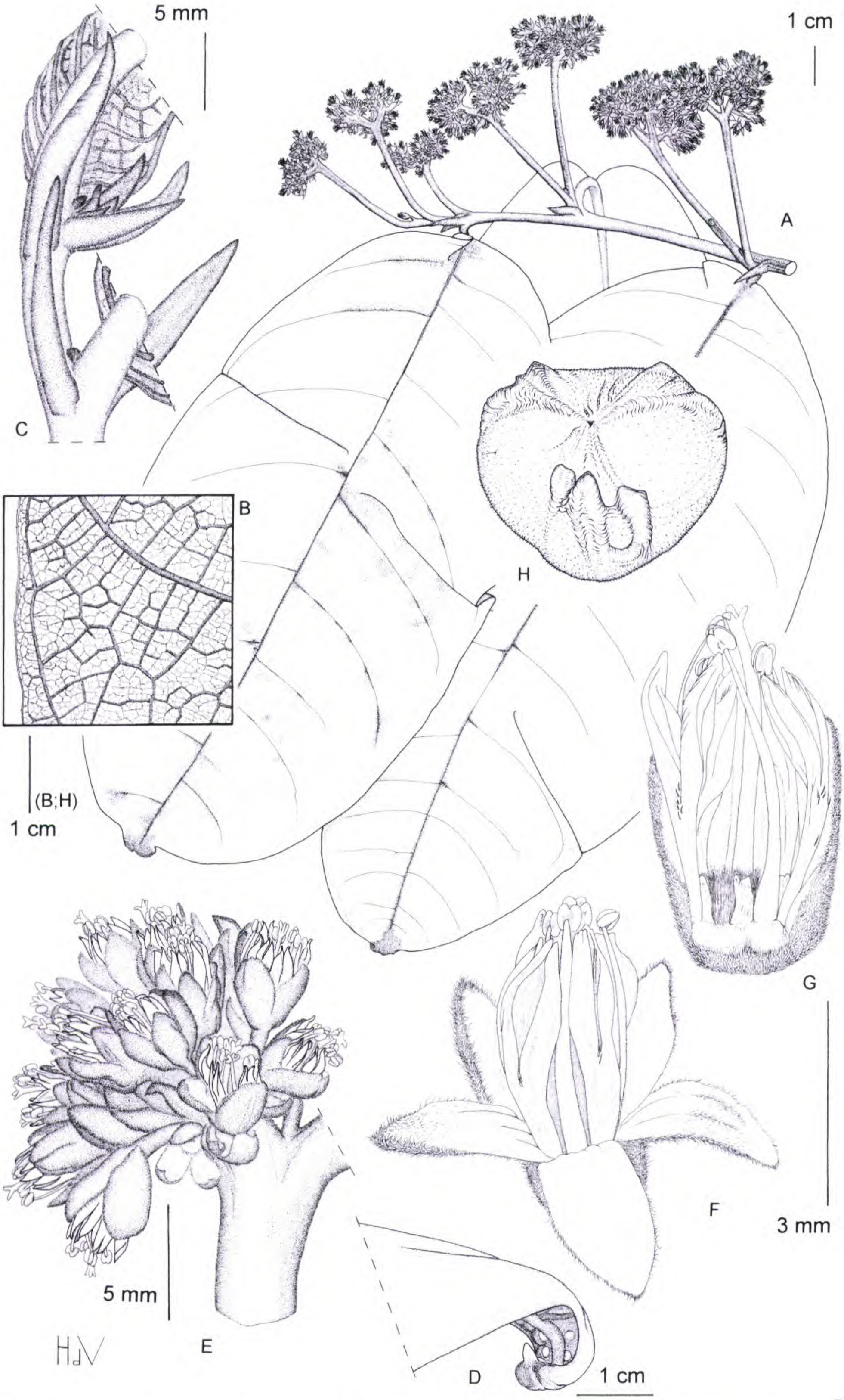

Figure 1. *Dichapetalum berendinae* Breteler. —A. Flowering branch. —B. Detail of leaf beneath. —C. Young branch with stipules. —D. Detail of leaf apex. —E. Part of inflorescence. —F. Flower. —G. Flower, two sepals, two petals, and one stamen removed. —H. Fruit (the horn-like blunt appendages are the carpels that did not develop a seed). A, B, E, after *Breteler c.s. 12400*; C, D, after *Breteler c.s. 12299*; F, G, after *Breteler c.s. 12180*; H, after *Breteler et al. 14883*.

rounded at apex. Stamens free, erect, slightly longer than petals, 3.5–5 mm long, glabrous; anthers 0.4–0.5 mm long. Staminodes subquadrate to obtriangular-oblong, up to 0.6 × 0.4 mm, apex bilobed to emarginate, glabrous or with a very few hairs inside. Pistil equal to or slightly longer than stamens; ovary 3-locular, depressed globose, 0.5–1 mm long, velutinous; style glabrous, 3–4 mm long, shortly 3-lobed apically. Fruit yellowish at maturity, densely velutinous, from subglobose and 2 cm diam. in 1-seeded fruits to depressed-globose and slightly 3-lobed to 3-angled and 2 × 3 cm in 3-seeded ones; carpels distinctly nerved on dorsal side; mesocarp 3–4 mm thick, juicy, ± fibrous; endocarp consisting of a palisade-like layer 1–1.5 mm thick. Seed subellipsoid, ca. 12–14 × 10 mm; seed coat rather firm, ca. 0.2 mm thick, brown, smooth, glabrous.

Etymology. This species is named in honor of Berendina J. M. Breteler-Klein Breteler, wife of the author and co-collector of the type specimen.

Phenology. Flowering from November to March; fruiting in February.

Distribution and habitat. Dichapetalum berendinae is a tropical lowland rain forest species from central and southeastern Gabon; altitudes up to ca. 600 m.

Paratypes. GABON. 30 km E of Lastoursville, *F. J. & B. J. M. Breteler 12180* (WAG); 40 km E of Lastoursville, *F. J. & B. J. M. Breteler 12299* (WAG), *12352* (WAG); 5–10 km W of Boungou-Madouma Railway Station, *F. J. & B. J. M. Breteler 12500* (LBV, MO, WAG); 40 km E of Lastoursville, *F. J. & B. J. M. Breteler 12577* (LBV, MO, P, WAG); near Sébé R., E of Lastoursville, *F. J. & B. J. M. Breteler 12639* (LBV, MO, WAG); Makandé, 65 km SSW of Booué, *Breteler et al. 14883* (LBV, WAG), *15238* (LBV, WAG), *15269* (LBV, MO, P, WAG); W of Offoué R., ± 85 km SSW of Booué, *Breteler 15807* (WAG); Forêt des Abeilles, E of Lopé Reserve, *McPherson 16238* (LBV, WAG); Makandé, 65 km SSW of Booué, *Wieringa et al. 4110* (WAG).

Note. The sterile specimens *Breteler 6304, 6399, 6438,* and *6606,* cited as *Dichapetalum heudelotii* (Planchon ex Oliver) Baillon by me in 1979, most probably belong here, too.

For identification see under *Dichapetalum inaequale.*

Dichapetalum findouense Breteler, sp. nov. TYPE: Gabon. Ndogo Lagoon, Findou I., 14 Nov. 1993 (fl, fr), *R. Hagens & F. J. Breteler 67* (holotype, WAG; isotypes, K, LBV, MO, P). Figures 2, 5.

Dichapetalo cymuloso similis pilositate ramunculorum foliorumque, floribus atri-exsiccatis et fructibus glabris, sed differt floribus multum parvioribus, staminibus brevioribus quam petalis (in *D. cymuloso* longioribus) et fructibus longi-acuminatis.

Lianescent shrub or liana with hollow orthotropic shoots, the plagiotropic ones hollow or not; branchlets ± strigose, ± glabrous when older, with brown bark with a few lenticels. Stipules ± appressed, narrowly triangular, 1–3.5 mm long, hairy as branchlet, caducous. Leaves: petiole 1–4 mm long, terete to semiterete, hairy as branchlet, especially on upper side; lamina papery, elliptic to obovate-elliptic, (2–)2.5–3(–3.5) times as long as wide, (5–)8–12 × (2–)3–4.5 cm, rounded to obtuse at base, acuminate at apex, the acumen up to 1 cm long, rounded at top, midrib and the 5 to 7 pairs of main lateral nerves as well as the tertiary venation prominent on both sides, more distinctly so beneath, strigose on margin and on midrib on both sides, to a lesser extent on the main lateral veins beneath, the latter glabrous or with a very few hairs above in very young leaves, the indumentum most persistent on midrib, especially above; glands small, scattered, below only or if on both sides then more numerous below. Inflorescence up to 9-flowered, appressed-puberulous; peduncle 1–4 mm long; bracts and bracteoles narrowly ovate to triangular, up to 1 mm long. Pedicel 0.5–3 mm long, the upper part 0.5 mm long, appressed-puberulous. Sepals erect or nearly so, ovate-oblong, 1.5 × 0.5–0.8 mm, appressed-puberulous outside and mainly so on upper part inside. Petals suberect, ± free from filaments, narrowly obovate to elliptic in outline, 1.5–2 mm long, 0.2–0.3 mm bilobed, glabrous; lobes concave, rounded at apex. Stamens ± as long as sepals, shorter than petals, ca. 1.5 mm long, glabrous; anthers 0.3 mm long. Staminodes subquadrate in outline, ca. 0.3 × 0.3 mm, apex bilobed or not, glabrous. Pistil shorter to slightly longer than stamens, 1–1.5 mm long; ovary 2- or 3-locular, shortly velutinous; style glabrous, 2- or 3-lobed apically. Fruit ± yellow, ellipsoid, long-beaked, 4.5–6 cm long (beak inclusive), up to ca. 2.5 cm diam. in 1-seeded fruit, glabrous; beak 1.5–2 cm long; exocarp and juicy mesocarp together up to 3 mm thick; endocarp ± papery, fibrous, muricate outside, smooth and glabrous inside; seed ovoid, slightly laterally compressed, 2.8 × 1.8 cm, with a thin, brown, smooth seed coat.

Etymology. This species was first collected on the island Findou in the Ndogo Lagoon, hence its geographic epithet of findouense.

Distribution and habitat. Dichapetalum findouense is known only from two localities in Gabon, both in the rain forest at 0–100 m altitudes.

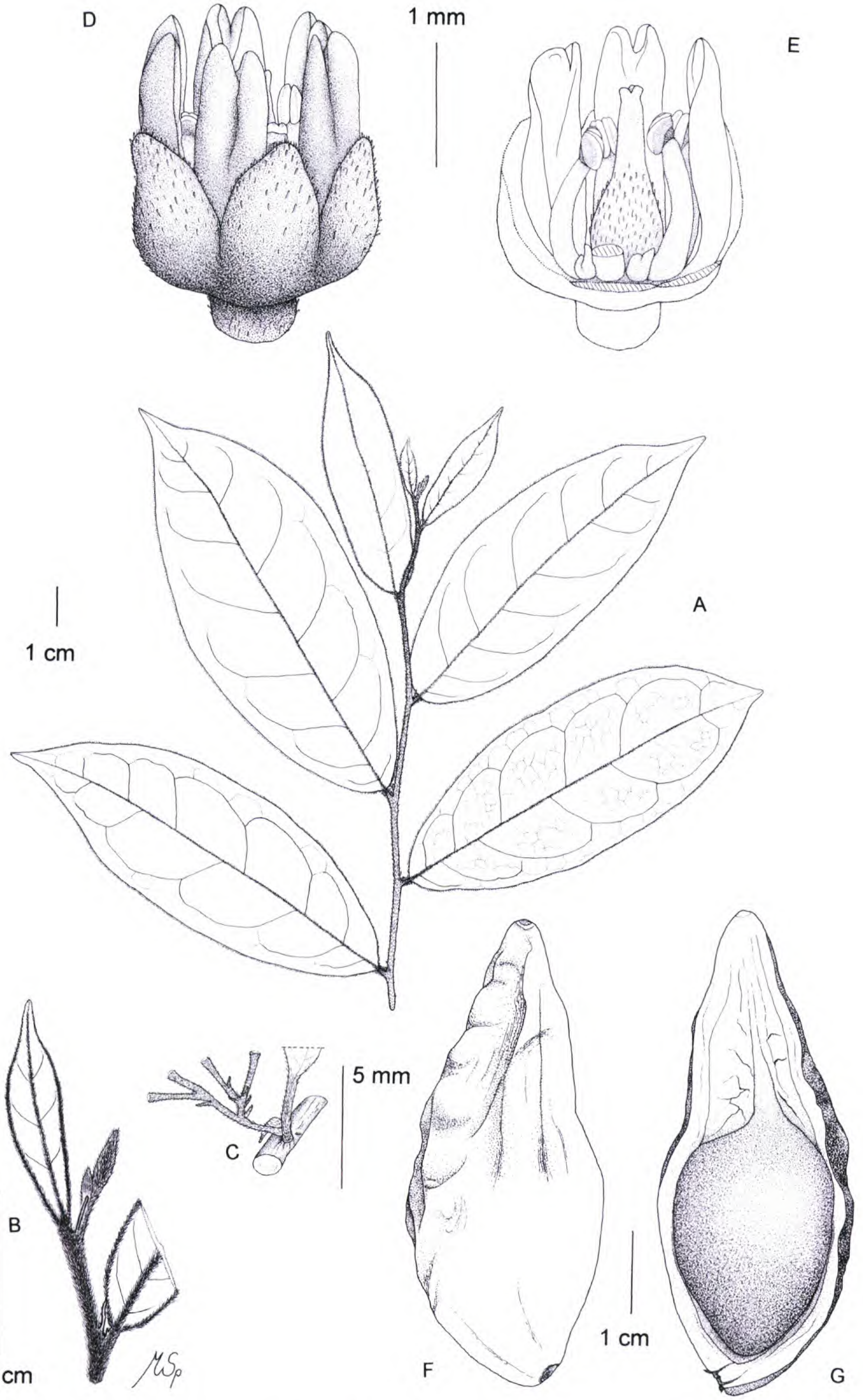

Figure 2. *Dichapetalum findouense* Breteler. —A. Leafy branch. —B. Young shoot with stipules. —C. Inflorescence branches. —D. Flower. —E. Flower, two sepals, two petals, and one stamen (partly) removed. —F. Fruit. —G. Fruit in longitudinal section showing the apiculate endocarp. A–C, F, G, after *Hagens & Breteler 67*; D, E, after *J. J. de Wilde et al. 11500.*

Paratype. GABON. Near Ndjolé, *J. J. de Wilde et al. 11500* (K, LBV, MA, MO, P, WAG).

With respect to Key II: Central African Species (Breteler, 1986: 22–28), *Dichapetalum findouense* will key out at two different couplets because it has either a 2- or a 3-carpellate gynoecium. When, at couplet 43, a 2-carpellate gynoecium is chosen it will lead to couplet 47, where 47a is the best choice because of the glabrous fruits. A new wording of 47a and the insertion of a new couplet 47* will accommodate *D. findouense*:

47a Branchlets glabrous to sparsely puberulous or strigose; inflorescence a sessile or very shortly peduncled, up to 9-flowered cymule; fruits glabrous 47*

47*a Branchlets glabrous to sparsely puberulous; petiole 2–6(–10) mm long, the lamina with glabrous margin; petals, stamens, and pistil subequal in length; Cameroun, Gabon . . . . . *D. minutiflorum*

47*b Branchlets ± strigose; petiole 1–4 mm long, the lamina with strigose margin; petals, stamens, and pistil unequal in length; Gabon . . . . . *D. findouense*

The choice for a 3-carpellate gynoecium leads to couplet 60 in Key II (Breteler, 1986: 27), where *Dichapetalum bodyi* and *D. cymulosum* are separated. The following modifications are proposed:

60a Leaves drying greenish to pale-brown, (8–)11–15(–18) × 3.5–6(–9) cm, midrib glabrous above or nearly so; Gabon, Congo, western Zaire . . . . . *D. bodyi*

60b Leaves drying dark brown to black, (3–)8–12(–15) × (1–)3–4(–5)cm, midrib always distinctly hairy above 60*

60*a Sepals reflexed, 2–2.5 × 1.5 mm; petals erect-spreading 2.5–3(–3.5) mm long, 1–1.5 mm bilobed; stamens distinctly longer than petals, 3–4(–4.5) mm long; SE Cameroun . . . *D. cymulosum*

60*b Sepals suberect, 1.5 × 0.5–0.8 mm; petals erect, 1.5–2 mm long, 0.2–0.3 mm bilobed; stamens distinctly shorter than petals, ± 1.5 mm long; Gabon . . . . . *D. findouense*

For the *Flore du Gabon* (Breteler, 1991: 30–35) the key to the species has to be changed as follows for the 2-carpellate gynoecium:

42. Jeunes rameaux glabres à pubérulence éparse et très tôt glabrescents ou jeunes rameaux ± strigose; inflorescence en cymule sessile ou courtement pédonculé, jusqu'à 9-flore, fruits glabres.

42 bis. Jeunes rameaux glabres à pubérulence éparse et très tôt glabrescents; pétiole 2–6(–10) mm de long, limbe à marge glabre; pétales, étamines et pistil de même longueur environ . . . . . *D. minutiflorum*

42 bis*. Jeunes rameaux ± strigoses; pétiole 1–4 mm de long, limbe à marge strigose; pétales, étamines et pistil de longueur différente . . . . . *D. findouense*

For the 3-carpellate gynoecium in the *Flore du Gabon* the following should be applied:

53*. Feuilles différentes; si fruits lobés, alors plusieurs graines.

53 bis. Pétales longs de 3,5–4,5 mm, 1–2 mm bilobés; étamines plus longues que les pétales, longues de 4–5 mm . . . . . *D. bodyi*

53 bis*. Pétales longs de 1,5–2 mm, 0,2–0,3 mm bilobés; étamines plus courtes que les pétales, longues de ± 1,5 mm . . . . . *D. findouense*

Dichapetalum inaequale Breteler, sp. nov. TYPE: Gabon. Bambidie, ± 30 km E of Lastoursville, 7 Oct. 1997 (fl), *F. J. Breteler & M. Leal 14251* (holotype, WAG; isotypes, G, K, LBV, MA, MO, P, PRE, US). Figures 3, 5.

Dichapetalo crassifolio similis ramis brunneis lenticellatis, foliis coriaceis fere glabris et forma inflorescentiae, sed differt absentia exsudati in ramis, staminibus petalis coalitis et lobis petalorum distinctis.

Medium-sized liana. Branches brown, lenticellate, glabrous or glabrescent. Branchlets (sub)appressed-puberulous, glabrescent with age. Stipules ± appressed, narrowly ovate-triangular, 2–5 mm long, appressed-puberulous both sides, caducous. Leaves: petiole subterete, grooved above, (2–)4–5(–8) mm long, appressed-puberulous; lamina coriaceous, elliptic to obovate, rarely ovate, usually obliquely so, 2–3 times as long as wide, (5–)9–13(–14) × (2.5–)4–5(–6) cm, rounded to cuneate and usually unequal-sided at base, acuminate at apex, the acumen ± acute to rounded, 0.5–1(–1.5) cm long; sparsely appressed-pubescent on both sides when young, soon glabrescent, especially so above, midrib impressed above, prominent beneath, the 5 or 6(to 7) pairs of main lateral nerves ± plane and rather indistinct above, plane to slightly prominent and ± distinct beneath; glands distinct, beneath only, a few large glands on leaf base and some smaller ones scattered on the surface. Inflorescence ± small, up to 12-flowered, once distinctly branched, appressed-puberulous; peduncle 2–7(–12) mm long; bracts and bracteoles narrowly triangular, up to 1.5 mm long, appressed-puberulous. Pedicel (sub)appressed-puberulous, 2–5 mm long, the upper part up to 1 mm long. Sepals erect to spreading to partly (sub)reflexed, ± free, elliptic-oblong, 3.5–4 × 1.5–2.5 mm, acute to rounded at apex, appressed-puberulous to tomentellous outside, more sparsely so inside. Petals pale-green with yellow lobes, erect, very shortly adnate to fil-

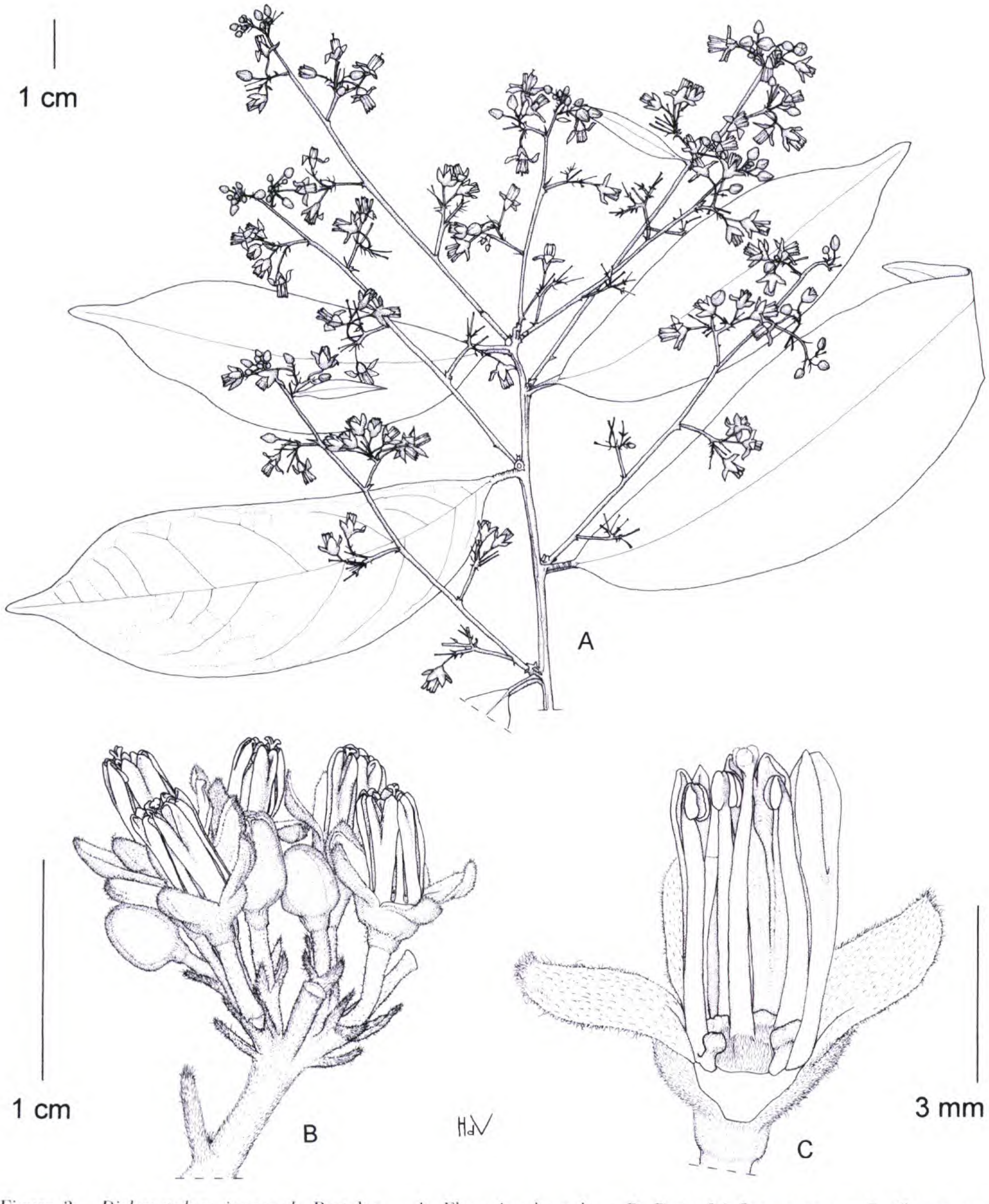

Figure 3. *Dichapetalum inaequale* Breteler. —A. Flowering branch. —B. Part of inflorescence. —C. Flower, two sepals, one petal, and two stamens removed. All after *Breteler & Leal 14251.*

aments at base, narrowly spathulate in outline, 5–6 mm long, ca. 0.5 mm bilobed, glabrous, the lobes concave. Stamens erect, slightly shorter than petals, 5–5.5 mm long, glabrous; anthers ± 0.5 mm long. Staminodes subquadrate, 0.5–0.7 mm long and wide, glabrous. Pistil 6–6.5 mm long; style glabrous, shortly 3-lobed at apex; ovary depressed, ± obscurely 3-lobed, ca. 0.5 mm long, densely ± white-velutinous. Fruits unknown.

Etymology. The epithet "inaequale" is derived from the characteristic asymmetrical leaves of the new species.

Distribution and habitat. Only twice collect-

ed from Gabon in the tropical rain forest at Bambidie, 30 km E of Lastoursville, at an altitude of ca. 300 m.

Paratype. GABON. Bambidie, 30 km E of Lastoursville, *Breteler & Leal 14155* (G, K, LBV, MA, MO, P, WAG).

For Key II: Central African Species (Breteler, 1986: 22–28) the new species *Dichapetalum berendinae* will key out at the first choice in couplet 68 together with *D. dewildei* Breteler. The new species *D. inaequale*, of which the fruits are unknown, will also key out here if hairy fruits are assumed, which is the most likely. To accommodate both new species it is proposed to change couplet lead 68a as follows and to insert the couplets 68* and 68** between 68 and 69.

68a Petal lobes distinct, concave, not incurved to inflexed 68*

68*a Branchlets with (long) persistent, brown-to-mentellous indumentum; stipules (5–)8–12(–14) mm long, ± (long) persistent; leaves (12–)14–25(–46) × (6–)7–13(–21) cm, with 10 to 16 pairs of secondary nerves; Gabon . . . . . *D. berendinae*

68*b Branchlets glabrous or glabrescent; stipules 2–5 mm long, caducous; leaves (5–)8–13(–18) × (2.5–)4–7(–10) cm with 4 to 7 pairs of secondary nerves 68**

68**a Leaves drying dark-brown to black, 1.5–2 times as long as wide, ± symmetrical, glabrous or only with appressed-puberulous midrib and secondary nerves; petals 3–4.5 mm long, bilobed for 0.5–1.5 mm; Cameroun, eastern Zaire . . . . . *D. dewildei*

68**b Leaves drying pale-green, 2.5–3 times as long as wide, usually asymmetrical, hairy on entire surface when young; petals 5–6 mm long, bilobed for 0.5 mm; Gabon . . . . . *D. inaequale*

In the *Flore du Gabon* (Breteler, 1991: 30–35) *Dichapetalum berendinae* will key out at the end with *D. dewildei*, as will *D. inaequale* when it is assumed that its fruits will be hairy. Lead 60* should be changed as follows:

60*. Style glabre dans sa partie inférieure ou seulement avec des poils très rares; sépales longs de 2,5–4,5 mm 61

The separation of these three species can be similarly done for the key to the Central African Species (Breteler, 1986: 22–28), by extending the key in this flora with two additional couplets, 61 and 62.

61. Branches avec un indumentum brun-tomentelleux, persistant; stipules (5–)8–12(–14) mm de long, ± persistants; feuilles (12–)14–25(–46) × (6–)7–13(–21) cm, avec 10–16 pairs de nervures laterales . . . . . *D. berendinae*

61*. Branches glabres ou glabrescentes; stipules 2–5 mm de long, caduques; feuilles (5–)8–13(–18) × (2,5–)4–7(–10) cm, avec 4–7 pairs de nervures latérales.

62. Feuilles brun-foncés à noir à sec, 1,5–2 fois plus longue que large, ± symétriques, glabres ou seulement pubescent sur les nervures principales; pétales 3,5–4 mm de long, 0,5–1,5 mm bilobés . . . . . *D. dewildei*

62*. Feuilles vert-clairs à sec, 2,5–3 fois plus longue que large, le plus souvent asymétriques, à pubescence sur toute la surface chez les jeunes feuilles; pétales 5–6 mm de long, 0,5 mm bilobés . . . . . *D. inaequale*

Dichapetalum mathisii Breteler, sp. nov. TYPE: Gabon. Makandé, ca. 65 km SSW of Booué, 26 Jan. 1999 (fr), *F. J. Breteler, G. Caballé. I. Issembé, Y. Moussavou, O. Pascal & L. Pyot 14787* (holotype, WAG; isotypes, K, LBV, MO, P). Figures 4, 5.

Dichapetalo angolense similis ramis cavis et inflorescentia magna, sed differt indumento ramunculi, folii inflorescentiaeque brevi monotypico, stipulis indivisis interdum dentatis et fructu lobato.

Liana up to at least 50 m long and 12 cm diam. or lianescent shrub. Branches gray-tomentellous, hollow. Branchlets hollow, brown-tomentellous, the same indumentum present on stipules, petioles, inflorescences and usually on the main nerves of the leaves, more rarely on the entire lower surface. Stipules narrowly ovate-triangular, 4–9(–11) mm long, margin entire, at most (sub)dentate, caducous. Leaves: petiole ± semiterete to subterete, ridged above or not, (6–)7–12(–19) mm long; lamina firmly papery to coriaceous, obovate, sometimes elliptic, more rarely ovate-suborbicular, (1–)1.5–2(–2.5) times as long as wide, (10–)12–25(–35) × (5–)8–13(–21) cm, usually obtuse to cordate, more rarely rounded, and often unequal-sided at base, retuse or emarginate to obtuse at apex with a mucronate-like tip of at most 5 mm long; midrib impressed above, prominent beneath, the (7)8 to 10(12) pairs of secondary nerves plane to slightly impressed above, prominent beneath, the tertiary nervation prominent beneath, ± indistinct above; glands small, present on both sides, ± well dispersed. Inflorescence many-flowered, distinctly 4 to 6 times branched, sometimes branched in the axil, i.e., at the very base, sometimes arranged on shoots with very strongly reduced leaves only; peduncle up to 1 cm long; bracts and bracteoles narrowly ovate-triangular (0.5–)1–5 mm long. Pedicel up to 10 mm long, the upper part 1–2.5 mm long, hairy as calyx. Sepals reflexed, shortly united at base, oblong-elliptic, 2–3 × 1–1.5 mm, top ± acute, tomentellous outside, glabrous or appressed-puberulous on up-

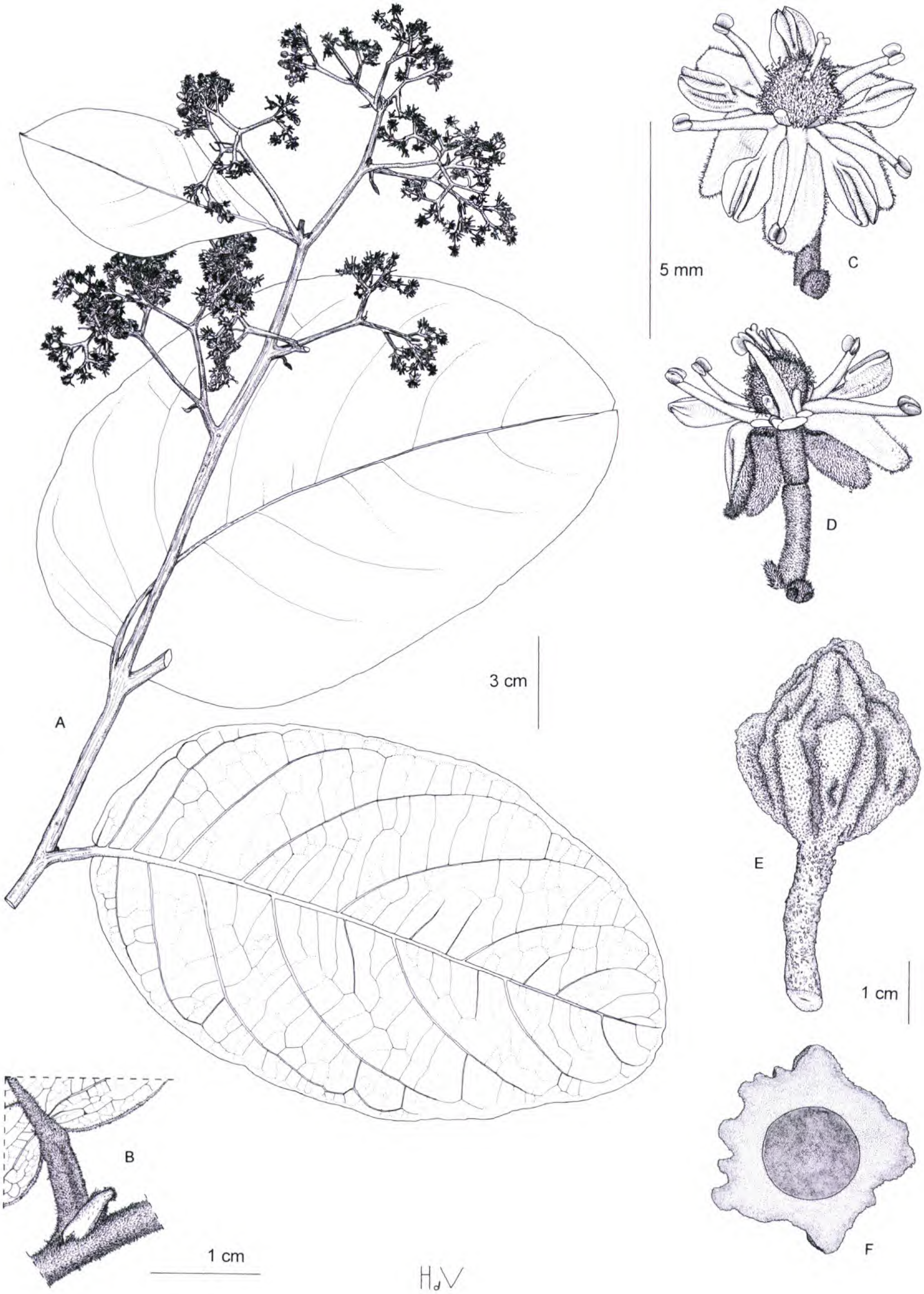

Figure 4. *Dichapetalum mathisii* Breteler. —A. Flowering branch. —B. Leaf axil with stipule. —C. Flower. —D. Flower, one sepal and two petals removed —E. Fruit. —F. Fruit in transverse section. A after *Reitsma c.s. 2662*; B, E, F, after *Breteler et al. 14787*; C, D, after *Breteler & Jongkind 10490.*

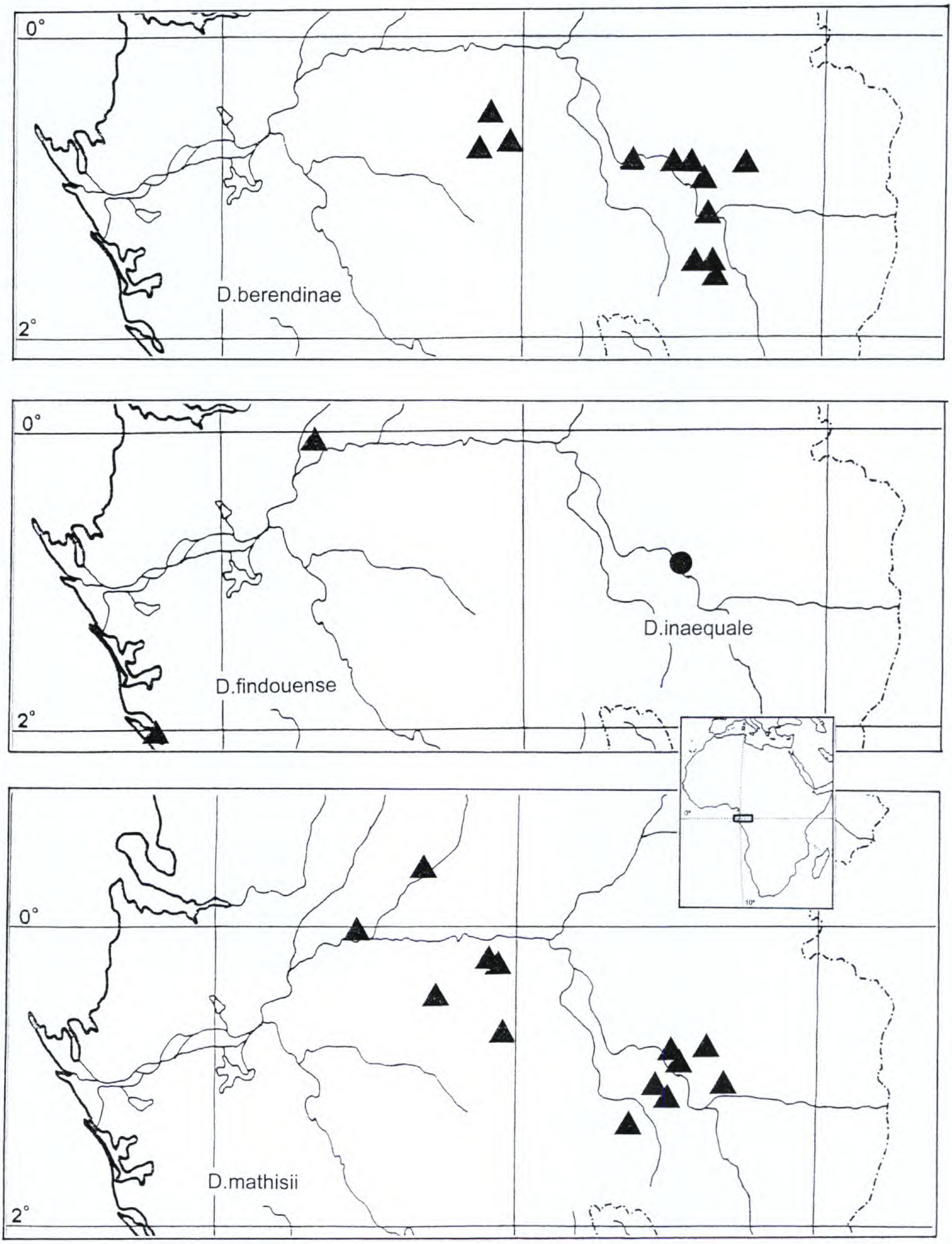

Figure 5. Distribution of the four new *Dichapetalum* species.

per part inside. Petals white, suberect to reflexed, obovate in outline, 2.5 mm long, 1.5 mm bilobed, lobes concave, glabrous except for a few hairs below lobes outside. Stamens white, spreading, slightly longer than petals, shortly adnate to calyx at base, 2.5–3.5 mm long, glabrous; anthers ca. 0.4 mm long. Staminodes oblong to obtriangular, up to ca. 0.8 mm long, sometimes slightly bilobed, gla-

brous or with a few hairs on apex. Pistil (2)3-carpellate (see note), 2–2.5 mm long; ovary and basal part of style with cotton-wool-like indumentum; style (2)3-lobed apically. Fruits globose-ellipsoid in outline, irregularly longitudinally ridged, 2.5–3.5 cm long, up to 3.5 cm diam., densely velutinous; exocarp together with firm mesocarp 8–10 mm thick, endocarp ± 0.5 mm thick, rather weak. Seed subellipsoid, (13–)15–20 × 10–15 mm, with a very thin, glabrous seed coat.

Etymology. This species is named after the recently born son Mathis (1999), whose father Laurent Pyot made a great effort on the sledge carried by a dirigible to collect the specimen that later became the type.

Phenology. Flowering from September to December; fruiting in January.

Distribution and habitat. Dichapetalum mathisii is a new species from the rain forest of central and southeastern Gabon, from altitudes up to ca. 600 m.

Paratypes. GABON. 10 km NE of La Lara, *Breteler & de Wilde 415* (WAG); km 48 Lastoursville–Moanda Rd., *Breteler 6447* (LBV, MO, WAG); 5–15 km NNW of Ndjolé, 11 Nov. 1991 (st), *Breteler & Jongkind 10371* (LBV, WAG), *10490* (LBV, WAG); 55 km E of Lastoursville, *F. J. & B. J. M. Breteler 12266* (WAG); 33 km Kessipoughou–Lifouta Gare Rd., *F. J. & B. J. M. Breteler 12328* (WAG); 20 km NW of Olounga, *Breteler 15676* (WAG); Lastoursville, *Le Testu 7652* (K, P, WAG), *Le Testu 7745* (P, WAG); 30–40 km SE of Achouka, *Louis, Breteler & de Bruyn 709* (BR, LBV, MO, WAG); 50 km SE of Achouka, *Louis, Breteler & de Bruyn 762* (BR, LBV, MA, MO, P, PRE, WAG); Lopé Reserve, *J. M. & B. Reitsma 2662* (LBV, WAG); 21 km SE of Lastoursville, *van der Maesen, Louis & de Bruyn 5886* (LBV, WAG).

Notes. One sterile specimen *(Breteler 6447)* and two flowering specimens *(Le Testu 7652 & 7745)* now identified as *Dichapetalum mathisii* have formerly been cited under *D. angolense* Chodat (Breteler, 1973: 59). They were at that time already recognized as somewhat aberrant, but the lack of sufficient evidence prevented their separation. The collection of full-grown fruits together with 10 other specimens collected since 1973 makes it now possible to distinguish *D. mathisii* quite satisfactorily as follows:

At least some indumentum on vegetative parts and inflorescences, consisting of dense short hairs and more sparsely scattered long hairs; stipules pinnatilobed to pinnatisect; fruits not ridged . . . . . *D. angolense*

Indumentum on vegetative parts and inflorescences uniformly tomentellous; stipules entire, at most (sub)dentate; fruits distinctly ridged . . . . *D. mathisii*

In *Breteler & Jongkind 10490* some flowers with 2-carpellate pistils have been observed, but they clearly are a small minority and, moreover, have been found in this collection only. It may, however, indicate a relationship between *Dichapetalum mathisii* and the closely related *D. angolense* and *D. bocageanum* (Henriques) Engler. The close relationship between the latter two species has been discussed earlier (Breteler, 1973: 60).

The segregation as *Dichapetalum mathisii* from formerly *D. angolense* makes it necessary to change Key II: Central African Species (Breteler, 1986: 22–28) at couplet 9 as follows:

9a Stipules pinnatilobed to pinnatisect, usually ± long persistent 10
9b Stipules entire, at most (sub)dentate, or stipules early caducous 11

Dichapetalum mathisii will now come out under 9b and will key out at 20a together with *D. beilschmiedioides* Breteler (Breteler, 1973: 87). The insertion of couplet 20* in the key will separate these two species:

20a Petiole (5–)7–12(–19) mm long; branches usually hollow; Gabon 20*
20b Petiole (1–)2–5(–10) mm long; branches solid 21
20*a Branches and branchlets glabrous or glabrescent; leaves glabrous or nearly so . . . . . *D. beilschmiedioides*
20*b Branches and branchlets densely tomentellous; leaves tomentellous at least on petiole and part of midrib . . . . . *D. mathisii*

For the *Flore du Gabon* (Breteler, 1991: 30–35) similar changes have to be made at couplet 9:

9. Stipules pinnatilobées à pinnatiséquées, ± long persistantes . . . . . *D. angolense*
9*. Stipules entières ou au plus dentées, ou stipules tôt caduques.

Then *Dichapetalum mathisii* will key out at couplet 18 together with *D. beilschmiedioides* (Breteler, 1973: 87). A small change of couplet 18 and the insertion of couplet 18a as follows will separate the two species:

18. Petiole long de (5–)7–12(–19) mm; rameaux le plus souvent creux.
18a. Rameaux glabres ou glabrescents; feuilles glabres ou presque . . . . . *D. beilschmiedioides*
18a*. Rameaux densément tomenteux; feuilles au moins tomenteuses sur le pétiole et une part de la nervure médiane . . . . . *D. mathisii*

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Two New Species and a New Combination in Southeastern United States *Xyris* (Xyridaceae) from Florida

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Abstract. Two new species of *Xyris* from peninsular Florida, in the southeastern United States, are described, illustrated, and discussed as to their ecological, geographical, and taxonomic relationships with other *Xyris*. *Xyris calcicola* is found primarily in central and southern Florida in calcareous habitats. *Xyris correlliorum* is endemic to southern Lake Wales Ridge lakes and is distinguished by its evident rhizomes, deeply lacerate petals, and elongated spikes. *Xyris floridana* is proposed as a change in taxonomic rank. A key is provided for all 24 *Xyris* species in Florida.

Key words: coastal plain, endemic, Florida lakes, Lake Wales Ridge, Xyridaceae, *Xyris*.

The genus *Xyris* L. is the only North American representative of the family Xyridaceae, and is recognized by its scapose habit, dense spike, and 3-petaled yellow or white flowers. Few species were described from the United States until Chapman (1860) published his *Flora of the Southern United States*, and it was another century until Chapman's named *Xyris* species were widely recognized as distinct, with Kral's (1960) publication of the first *Xyris* treatment for Florida. Later, Kral (1966) published a comprehensive monograph on *Xyris* for the continental United States and Canada, recognizing 22 species and infraspecific taxa. Subsequently, three additional species have been described as southeastern United States endemics (Kral, 1978; Bridges & Orzell, 1987, 1990). Despite these treatments, there have been comparatively few intensive field studies of *Xyris* in peninsular Florida. Efforts by the authors to document the distribution and habitat relationships of *Xyris* species in this region have resulted in the two novelties described herein and led us to reexamine the taxonomy of the *Xyris difformis* complex. Both of the *Xyris* species described herein have been overlooked by past collectors, with only a few previous collections.

1. Xyris calcicola E. L. Bridges & S. L. Orzell, sp. nov. TYPE: U.S.A. Florida: Polk Co., disturbed, weedy, calcareous shell shoulder above roadside ditch on S side of Bravo Rd., E of Frostproof Rd., ca. 11 air mi. E of Avon Park, Avon Park Air Force Range, elev. 21.2 m, 20 Sep. 1994, *S. L. Orzell & E. L. Bridges 23198* (holotype, USF; isotypes, BRIT, DUKE, FLAS, FSU, FTG, GA, MO, NCU, NY, TEX, US). Figure 1.

Xyridi floridanae similis sepalis lateralis laceratis quam bracteis spicae brevioribus, foliis ad bases subroseis vel purpureis, et seminibus farinosis, sed differt foliis ac scapis torsivis, spicis apice scapi ad angulum divergentibus, spicae bracteis inferis acute carinatis, bracteis spicae area dorsali viridi, et petalis obovatis.

Perennial herb, loosely to densely caespitose, in clumps to 15 cm diam., 3–8 dm high; the roots slender, fibrous. Leaves narrow, 15–30 cm × 1–3 mm, strongly spirally twisted, the margins and surfaces scarcely if at all tuberculate, appearing smooth at 60×, finely roughened at 180× but not distinctly tuberculate; leaf sheaths slightly expanded, a deep pink to reddish purple for the lowermost 5–10 cm. Sheath of the scape tight, reddish purple, 5–10 cm long, with a linear-subulate blade 10–25 mm long, much shorter than the principal leaves. Scapes linear, 3–8 dm × 1.0–1.5 mm at apex, spirally twisted, strongly tuberculate-scabrous, basally angled or blocky and several ridged, becoming slightly flattened and bi-costate above, the two major costae strongly tuberculate-scabrid and comprising the scape edges, with 2–4 additional prominent costae on each face of the scape. Spikes broadly ovoid, rounded to slightly acute, at maturity ca. 9–16 × 5–8 mm, several-flowered, when mature diverging from the apex of the scape at a 10° to 20° angle, the bracts tightly spirally imbricate; lower-

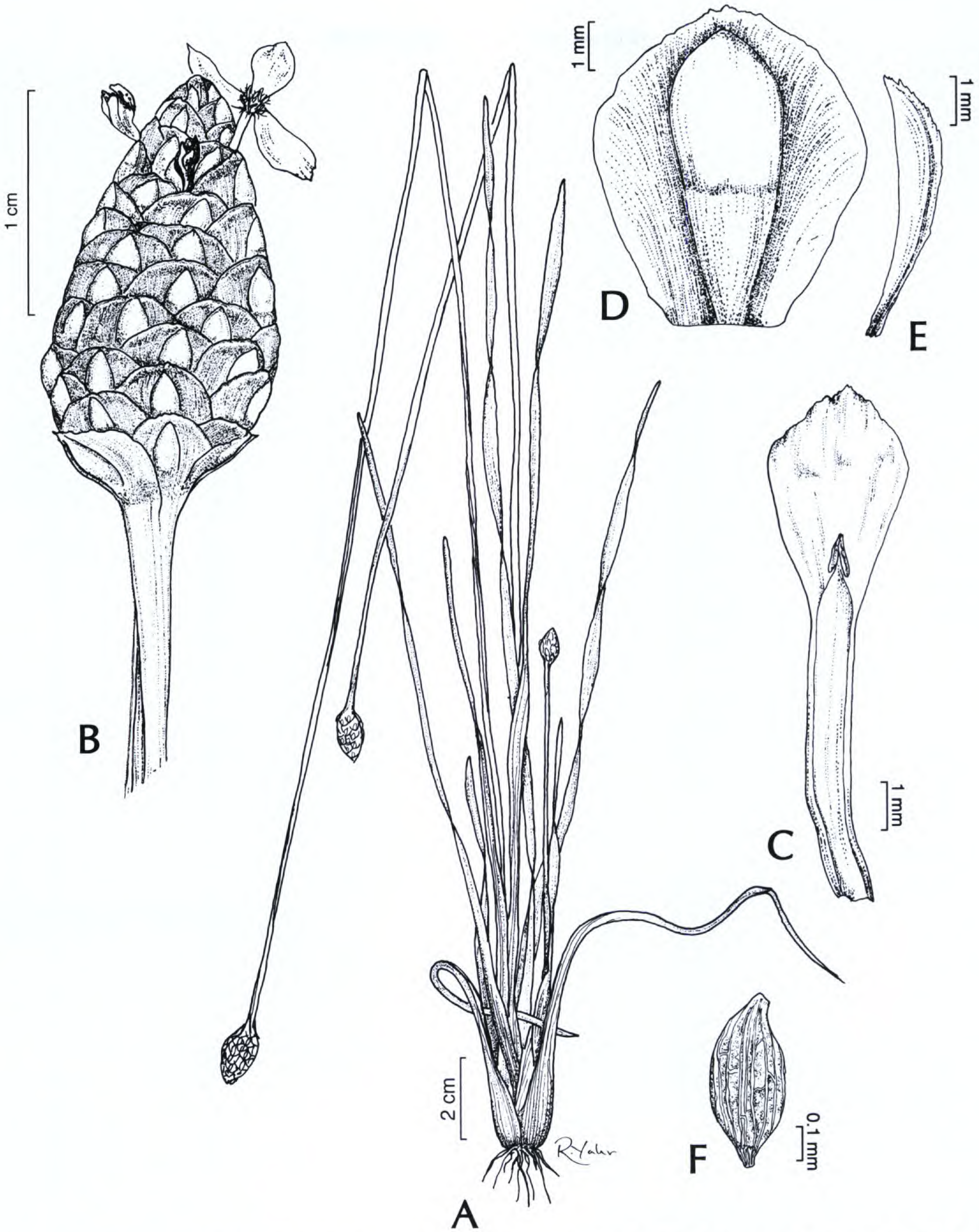

Figure 1. A–F. *Xyris calcicola* E. L. Bridges & S. L. Orzell, based upon the USF holotype collection, *S. L. Orzell & Bridges 23198*. —A. Habit. —B. Spike. —C. Petal blade, stamen. —D. Fertile bract. —E. Lateral sepal. —F. Seed.

most bracts of spike sharply keeled along the green dorsal area, the other bracts with rounded backs; bracts of spike orbicular, with an ovate-triangular bright green prominent dorsal area, sharply contrasting with the dark brown sides, the boundary between the two areas rather abrupt. Lateral sepals included, 5–6 mm long, linear-curvate, the keel irregularly lacerate. Petal blades obovate to somewhat obovate-obtriangular, yellow, ca. 4 mm long, 3–4 mm wide near apex, 2 mm wide at base, the base narrowed-cuneate, the apex broadly acute to rounded, somewhat irregularly shallowly lacerate to

emarginate. Staminodia bi-brachiate, the branches slightly penicillate, rather small, held erect in center of flower. Capsule ellipsoid, ca. 3–4 × 2.5–3 mm, the placentation parietal. Seed ellipsoid to broadly ellipsoid, 0.3–0.4 mm long, somewhat obliquely caudate-tailed at one or both ends, opaque, the surface dark brown to grayish brown, partially obscured by a yellowish farinose substance, with about 12–18 regularly spaced longitudinal lines of papillae, and several much fainter irregular cross lines.

Etymology. *Xyris calcicola* is named for its preference for calcareous habitats, in contrast to the acidic habitat preferences of most southeastern coastal plain species of *Xyris* in the United States. The only other U.S. *Xyris* with calcareous habitat preference is *Xyris tennesseensis* Kral, which occurs on wet calcareous substrates (Kral, 1978), in fens (calcareous seepage wetlands) developed over dolomite or limestone strata in the interior provinces of Alabama, Georgia, and Tennessee. *Xyris tennesseensis* differs from *X. calcicola* in its bulbous plant base and leaves that are wider (5–10 mm) and flat to only slightly twisted.

Phenology. Flowering from mid summer until late fall, from August until November. Flowers opening in late morning, generally from about 10:00 to 10:30 AM, and closing in early afternoon, from about 12:30 to 1:00 PM. The withered flower petals persist on spikes as gray-black rounded masses for short periods, probably dehiscing within one week of anthesis.

Taxonomic relationships. Although somewhat cryptic, its remarkably consistent morphology and lack of intermediates with the often sympatric *Xyris floridana* and *X. jupicai* indicate the distinctiveness of *X. calcicola.* Despite sharing some characters with these species, *X. calcicola* has additional distinctive characters found in neither *X. jupicai* nor *X. floridana,* indicating that it is unlikely to be a hybrid or product of introgression.

Although *Xyris calcicola* shares the flexuous, twisted scapes and leaves found in *X. platylepis, X. scabrifolia,* and *X. chapmanii,* it seems to be part of the complex comprising *X. jupicai, X. difformis, X. curtissii,* and *X. floridana. Xyris jupicai* differs from *X. calcicola* in having flat or only slightly twisted scapes and leaves, a smooth scape, spikes held erect from the apex of the scape rather than diverging at an angle of 10° to 20°, obtriangular petals, which are truncate at the apex, a translucent seed, and in lacking sharply keeled lowermost bracts on the spike.

Xyris calcicola shares more characters with *X. floridana* than with any other species of the group. *Xyris floridana* differs from *X. calcicola* in lacking additional sharp scape ridges on the upper scape, lacking sharply keeled lower bracts on the spike, lacking sharply differentiated green dorsal areas on the bracts of the spike, and lacking sharply acute spikes at maturity. *Xyris calcicola* has obovate to somewhat obovate-obtriangular petals as opposed to the broadly ovate petal blades of *X. floridana.*

Distribution and ecology. *Xyris calcicola* occurs almost exclusively in calcareous habitats, primarily in southern and south-central Florida, and very rarely in northern Florida. It is occasional in wet marly soils overlying limestone and in herbaceous-dominated ecotones between wetland South Florida slash pine (*Pinus elliottii* Engelmann var. *densa* Little & Dorman) savannas and depression marshes in southern Florida. It also occurs in muhly grass [*Muhlenbergia capillaris* (Lamarck) Trinius var. *filipes* (M. Curtis) Chapman ex Beal] dominated marl prairies and calcareous South Florida slash pine savanna-flatwoods, particularly in the Big Cypress Region in Collier County. In southeastern Florida, it occurs on calcareous-influenced soils, primarily in the hydric pine savanna-flatwoods region of Martin and Palm Beach Counties. It is sporadic in south-central Florida in both disturbed and natural habitats. *Xyris calcicola* has been collected from the upper edges of calcareous roadside ditches, where crushed shell or marl has been used for road surface or subsurface fill. It also occurs in calcareous fringing wet prairies bordering depression wetlands found within the pine savanna-flatwoods/dry prairie landscape of south-central Florida (in Okeechobee and Polk Counties). Some calciphiles associated in native habitats include *Eriocaulon ravenelii* Chapman, *Heliotropium polyphyllum* Lehmann, *Iva microcephala* Nuttall, *Ludwigia microcarpa* Michaux, *Paspalum monostachyum* Vasey ex Chapman, *Rhynchospora colorata* (L.) H. Pfeiffer, *R. divergens* Chapman ex M. Curtis, *Schoenus nigricans* L., *Schizachyrium rhizomatum* (Swallen) Gould, and *Scleria verticillata* Muhlenberg ex Willdenow. All habitats for *X. calcicola* are generally in saturated soils that are inundated to a depth of 2 to 15 cm during the wet season. Botanists should search for *X. calcicola* in wet calcareous areas elsewhere in the outer coastal plain and in the Caribbean.

Paratypes. U.S.A. **Florida:** Baker Co., edge of cutover slash pine-cypress swamp, W of Sanderson, 22 Aug. 1991, *Orzell & Bridges 17972* (FLAS, FTG, MO, NY, USF); Collier Co., ecotone betw. pine rockland savanna & marl prairie, ca. 4.3 air mi. NE of Copeland, 29 Oct. 1993, *Orzell & Bridges 22538* (FTG), 11 Nov. 1994, *Orzell & Bridges 23442* (FLAS, FTG, MO, US, USF); Lee Co., clearcut wetland slash pine savanna, ca. 7.9 air mi. NE of Bonita Springs, 28 Nov. 1995, *Bridges & Mears 24147* (FTG, USF);

Monroe Co., wet slash pine-cabbage palm marly savanna, ca. 4 mi. W of Pinecrest, 11 Nov. 1994, *Orzell & Bridges 23443* (FTG, USF); Polk Co., calcareous roadside ditch, Avon Park Air Force Range, 11 Sep. 1993, *Orzell & Bridges 22350* (APAFR, FLAS, USF), 31 Oct. 1994, *Orzell & Bridges 23370* (APAFR, BRIT, FLAS, FTG, MO, USF); Okeechobee Co., calcareous wet prairie, ca. 10.4 mi. WNW of Fort Drum, 29 Oct. 1997, *Orzell & Bridges 25256* (FLAS, MO, USF); Osceola Co., wet roadside with shell, ca. 2 mi. E of Holopaw, 24 Aug. 1996, *Orzell & Bridges 25158* (FTG, USF); Palm Beach Co., marly hydric slash pine savanna, J. W. Corbett Wildlife Management Area, 18 Oct. 1995, *Orzell & Bridges 23842* (BRIT, FLAS, FTG, MO, NY, USF). Additional habitat and location data are available for Orzell & Bridges collections from the authors.

2. Xyris floridana (Kral) E. Bridges & Orzell, comb. nov. Basionym: *Xyris difformis* Chapman var. *floridana* Kral, Sida 2: 256. 1966. TYPE: U.S.A. Georgia: Chatham Co., 7 mi. N of Richmond Hill on wet sandy peat of bulldozed pine flatwoods, 21 Aug. 1963, *R. Kral 18941* (holotype, SMU [BRIT]).

While investigating the distinctiveness of *X. calcicola*, we also reexamined the taxonomy of *Xyris difformis* and its varieties. The *Xyris difformis* complex has been recognized as consisting of three varieties (Kral, 1966, 2000)—*Xyris difformis* var. *curtissii*, *X. difformis* var. *floridana*, and *X. difformis* var. *difformis*. *Xyris curtissii* was described as a species by Malme (1913), and Kral (1960) treated it as a variety of *X. serotina*. In 1966, Kral described *X. difformis* var. *floridana*, differentiating it from *X. serotina*. Kral in 1960 (p. 318) and later (Kral, 1966: 253–254), after much careful study and debate, recognized *Xyris difformis* var. *difformis* as distinct from *X. jupicai*. Kral (1960: 318) commented that future study of *X. difformis*, *X. serotina*, and *X. curtissii* might reduce them to subspecies status. In contrast, our study has led us to recognize these three taxa, as well as *X. floridana*, at the species level.

Xyris difformis is remarkably consistent in morphological characters on the southeastern U.S. coastal plain. It is distinguished from both *X. curtissii* and *X. floridana* in being much taller, typically solitary, broad-leaved, and having a broad scape, smooth leaves and scape (except for the scape ridges and leaf edges), and a distally widened scape with two prominent ribs. Its many-flowered ovoid spike with a rounded apex and larger lateral sepals to 7 mm long also help to separate it from both other entities. Its translucent seed separates it from *X. floridana*, and the numerous fine longitudinal lines on the seed separate it from *X. curtissii*. Throughout most of their ranges, *X. curtissii* and *X. floridana* are easily recognizable as distinct from *X. difformis*, with few or no intermediates even where more than one of these is sympatric. Typical *X. curtissii* is a low, caespitose plant with translucent seeds, where it is sympatric with *X. floridana* and *X. jupicai*. However, in northern Florida and elsewhere on the outer coastal plain there are some populations of *X. curtissii* that are slightly taller and with more erect leaves that resemble *X. floridana* vegetatively, but lack the farinose seeds of *X. floridana*. There is potential for hybridization and introgression between these species at some locations, but we have seen no specimens that simultaneously overlap in more than one or two characters. Notwithstanding the occasional intermediate herbarium specimen, in our experience and that of others with extensive field experience with *Xyris* (LeBlond & Sorrie, 2001: 300), they are justifiably recognized at the species level.

All three species are somewhat ecologically differentiated at least in Florida. Range and habitat descriptions are based on manuscripts in preparation for the *Flora of Florida* (Bridges, unpublished manuscript). *Xyris difformis* occurs in bay forests, along seepage streams, and in forested stream floodplains in the Florida panhandle east to Jefferson County, and also in Nassau County in northeast Florida. In Florida, it is typically associated with shaded muck or mucky peat substrates, usually where there is seepage or periodic flooding. Rangewide, the habitats are more diverse, including wet sands or sandy peats of flatwoods, pond margins, ditches, lakeshores, and alluvial habitats such as stream margins and floodplain forests. Although primarily a coastal plain species, *X. difformis* is wide-ranging from east-central Texas to its northern limits in New England and southeastern Canada. *Xyris curtissii* occurs in seepage areas and wetland pine savannas, in Florida primarily in the panhandle region east to Jefferson County, and also in Duval and Clay Counties in northeastern Florida. It occurs from southeastern Virginia to northern Florida and west to east-central Texas, and also Belize (Kral, 2000). In Florida, *X. floridana* occurs on moist sands and peaty sands in acidic, wet to wet-mesic pine savanna-flatwoods, wet prairies, and ecotones between pine flatwoods and wetlands. *Xyris floridana* is primarily an outer coastal plain species, with the largest number of collections from peninsular Florida, and is less common in the Florida panhandle. It ranges from southeastern North Carolina across rarely to southeastern Louisiana. It also occurs in Belize, Honduras, and Nicaragua (Kral, 2000).

Our observations are based upon hundreds of collections by the authors from several southeastern coastal plain states, examination in the field of nu-

merous large *Xyris* populations, and critical study of many herbarium specimens while preparing the *Xyris* treatment for the *Flora of Florida*. The overlapping ranges of the three taxa in Florida allowed us to study many sympatric populations in the field.

3. Xyris correlliorum E. L. Bridges & S. L. Orzell, sp. nov. TYPE: U.S.A. Florida: Highlands Co., emergent vegetation rooted in organic floating vegetation mats, along S shoreline of Lake Placid, elev. 28.7 m, 5 Sep. 1995, *S. L. Orzell & E. L. Bridges 23809* (holotype, USF; isotypes, BRIT, FLAS, FSU, FTG, GA, MO, NCU, NY, TEX, US). Figure 2.

Xyridi longisepalae similis sepalis lateralibus ciliatis versus basim laceratis versus apicem, sed differt rhizomatibus tenuibus elongatis squamosis, spicis 2–3.2 cm longis ca. 4 plo longioribus quam latioribus, sepalis latioribus inclusis vel a bracteis spicae parum exsertis, petalis profunde laceratis, et seminibus farinosis obscure alveolatis.

Perennial herb, the culms arising singly, or in rather dense clumps from thin, elongate, light tan scaly rhizomes, the clumps ranging from fairly small to forming an extensive dense turf of basal rosettes. Leaves of emergent plants erect to slightly spreading, linear-curvate, 10–15(–20) cm long, 1–3(–5) mm wide, lustrous, smooth, the margins somewhat pale and sometimes slightly tuberculate, the sheaths slightly expanded, stramineous or tan to pale pink. Sheaths of scape rather loose above, a lustrous tan to golden brown at the base (more evident on dried specimens), becoming duller colored above, 10–15 cm long, with an elongate acute blade from 3 to 6 cm long, the tip of the blade acute and becoming maroon to reddish brown, the total length of the sheath and blade nearly equaling or longer than the principal leaves. Scapes 30–50 cm tall, 1–2 mm wide, inconspicuously ridged, subterete below, becoming slightly 2-angled and biconvex above, the angles and surfaces smooth. Spikes narrowly lanceolate to narrowly oblong, blunt, when well-developed from 2 to 2.7(–3.2) cm long (but flowering and fruiting when only 1 cm long on some plants), (3–)5–7 mm wide, many-flowered, the bracts tightly spirally imbricate; bracts obovate to orbicular, 5–6 mm long, 4–5 mm wide, with a small ovate rather obscure gray-green dorsal area, and dark chestnut brown sides. Lateral sepals included (to very slightly exserted), linear to very slightly curvate, 5–6 mm long, blunt, the keel entire to slightly ciliate below, entire to slightly ciliate or lacerate above, the keel sometimes extending as a sharp point slightly beyond the blunt hyaline sepal tip. Petal blades obovate, cupped or twisted when fresh, yellow, 5–7 × 3–4 mm, with an irregularly deeply lacerate apex, the lacerations forming 5 to 8 narrow lobes at the apex of each petal, the lobes 1–1.5 mm long. Staminodia very conspicuous, bi-brachiate, to 4 mm long, the branches densely long penicillate. Capsule elliptic, ca. 3–4 mm long. Seed narrowly elliptic, 0.5–0.6 mm long, narrowed at the ends, dull brown, opaque, covered with a yellowish farinose substance, with ca. 12 prominent longitudinal ridges and very faint cross lines.

Etymology and history. Xyris correlliorum is named in honor of its first collectors, Donovan S. Correll (1908–1983) and Helen B. Correll (1907–2001). Upon completion of the *Flora of the Bahama Archipelago*, they began work on the *Flora of Florida* with Richard Wunderlin at USF in Tampa. Exploratory collecting by the Corrells for this project eventually led to the collection of *X. correlliorum*. Unsure of its identification, their specimen remained an enigma to the Corrells.

The senior author first noticed *Correll 52376* at FTG and USF while compiling distribution records of *Xyris* for the *Atlas of the Flora of Florida* (Wunderlin et al., 1996) in 1991. Neither of the two sheets could be definitively identified, since both lacked rhizomes, petal blades, and mature seeds. Over the next three years, repeated visits to the Correll collection site on Lake Placid failed to uncover any *Xyris* resembling the Correll specimen. However, in September 1995 the authors along with Rebecca Yahr gained access to newly purchased conservation lands on the south side of Lake Placid. Here we unexpectedly encountered an extensive population of the mystery *Xyris*, growing on floating vegetation mats near and along the lakeshore. Following this initial finding the second author conducted boat and bank surveys of other Lake Wales Ridge lakes, but these yielded only a few additional locations.

Phenology. Flowering in August and September, possibly extending until frost conditions. Petals open in late morning, mostly opening between 10:00 and 10:30 AM, and closing by 1:30 to 2:00 PM.

Taxonomic relationships. The deeply lacerate petal blades and evident rhizomes of *X. correlliorum* are unique among North American *Xyris*. Its narrowly elongate, blunt-tipped spikes, with an average length:width ratio of about 4:1, and some spikes exceeding 3 cm in length, are unlike any *Xyris* in the United States. The keel of the lateral sepal is somewhat intermediate between ciliate and lacerate, a characteristic similar to *X. longisepala*, which has much longer and narrower lateral sepals that are always exserted beyond the subtending bracts. The farinose seed of *X. correlliorum* is shared with *X. stricta*, *X. louisianica*, and *X. laxi-*

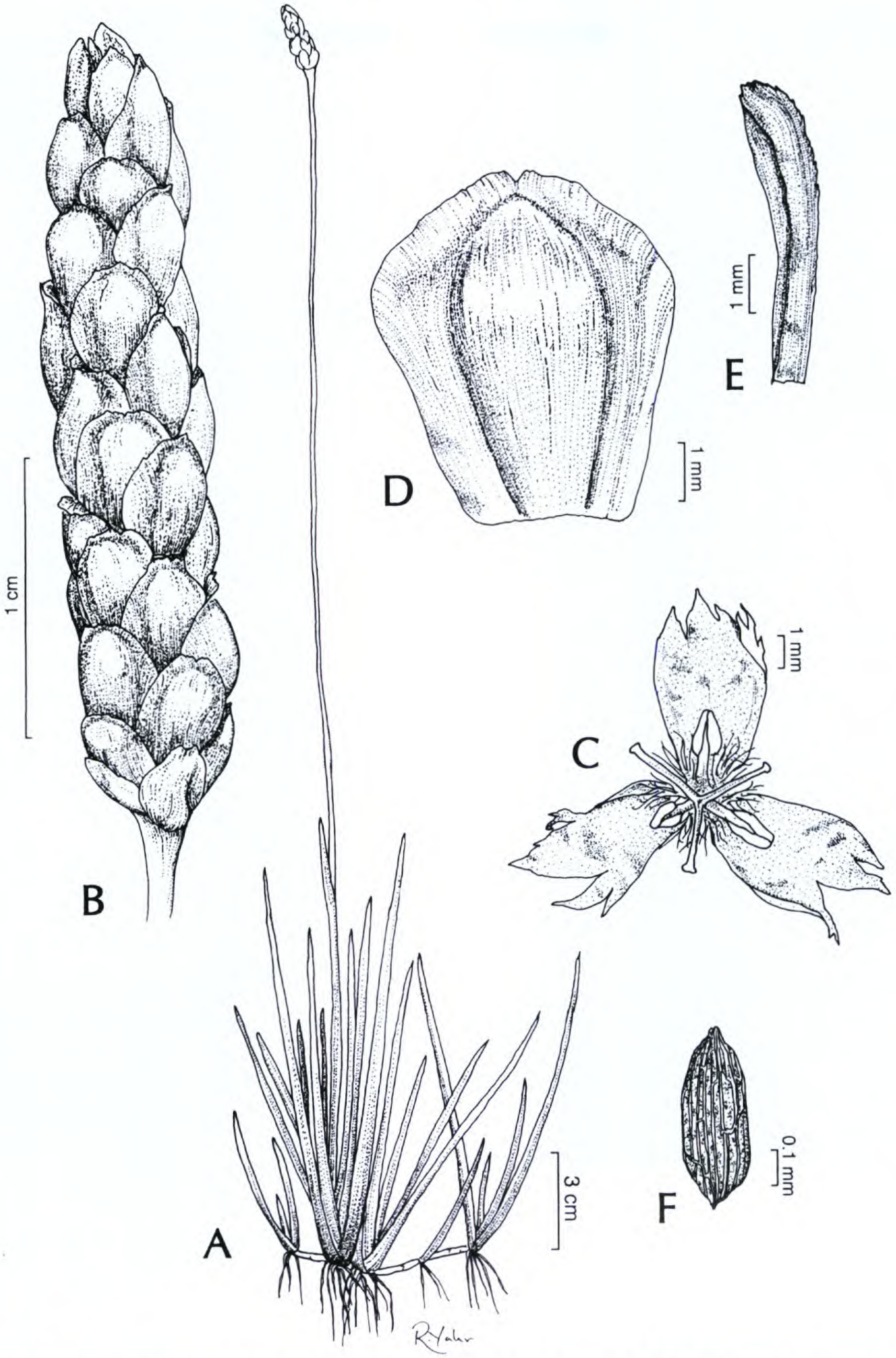

Figure 2. A–F. *Xyris correlliorum* E. L. Bridges & S. L. Orzell, based upon the USF holotype collection, *S. L. Orzell & Bridges 23809*. —A. Habit, plants with rhizomes. —B. Spike. —C. Flower, petal blades, stamens, stylar apex. —D. Fertile bract. —E. Lateral sepal. —F. Seed.

folia var. *iridifolia* (all of which are out of range and differ in other characters). *Xyris floridana*, *X. serotina*, and *X. calcicola* also have farinose seeds but differ from *X. correlliorum* in leaf and spike characters. The petal blades of *X. correlliorum* are deeply lacerate at the apex, to the point where they could almost be considered as lobed, with the lobes 1.0–1.5 mm long. All other species of *Xyris* in the

United States have petal blades that are entire, emarginate, slightly erose, or shallowly serrate, but never deeply lacerate as in *Xyris correlliorum*.

Distribution and ecology. Xyris correlliorum has been collected from three south-central Florida lakes: Lake Placid, Lake Annie, and Grassy Lake. All of these lakes lie near the southern terminus of the Lake Wales Ridge (LWR), a prominent sand ridge only a few kilometers wide but more than 150 km long, extending southward from southeastern Lake County to southern Highlands County. All of the lakes having *X. correlliorum* occur within the Intra Ridge Valley (White, 1970) of the LWR, a feature characterized by residual sandhills, relict beach ridges, and paleo-sand dunes (Brooks, 1981). They are part of a linearly aligned series of lakes extending some 320 km to the north along the Florida peninsular axis (Layne, 1979). Lakes Placid and Annie are relatively deep (17 and 20 m, respectively) solution depressions, which ultimately flow into the drainage basin for Lake Okeechobee. Lakes Placid and Annie are oligotrophic, clear, soft-water, nutrient-poor lakes with low alkalinity, low specific conductance (McDiffett, 1980) with sandy bottoms. Both lakes are considered to be astatic lakes because extreme variability in lake water levels is typical (Brenner et al., 1990).

Within these lakes, *Xyris correlliorum* occurs on floating mats or submerged along the lakeshore. These mats have emergent vegetation rooted in highly organic, buoyant, sphagnous mats that rise and fall with changes in water levels. Floating mats of short dense turfs of *X. correlliorum* mixed with *Drosera intermedia* Hayne, *Mayaca fluviatilis* Aublet, *Myriophyllum laxum* Shuttleworth ex Chapman, *Fuirena scirpoidea* Michaux, and *Sphagnum* sp. are typically found on the downwind side of the lake. These mats occur in the littoral zone downslope of forested seeps or deep xeric sands with scrub vegetation. Groundwater from forested seep or scrub soils percolates downslope onto the sandy lakeshore, and this telluric seepage may be an important habitat requirement for *X. correlliorum* and some of its associates. *Drosera intermedia, Eriocaulon lineare* Small, *Mayaca fluviatilis, Myriophyllum laxum*, and *Websteria confervoides* (Poiret) S. S. Hooper are all closely associated with *X. correlliorum*, and are very rare habitat specialists where they occur in south-central Florida. Each reaches its southern limit in Highlands County LWR lakes with seepage influence. In contrast, *X. correlliorum* is absent from peaty lakeshores, with dense, rank stands of non-native *Ludwigia peruviana* (L.) H. Hara, *Eragrostis atrovirens* (Desfontaines) Trinius ex Steudel, and *Panicum repens* L., with native *Typha domingensis* Persoon and *Pontederia cordata* L. *Xyris cor. elliorum* is also absent from littoral zones where mucky detrital deposits cover the sandy bottom. Vegetative *X. correlliorum* can grow submerged in clear water up to 70 cm in depth, where it can form dense rhizomatous stands on lakeshore bottom sands. When submersed, it rarely flowers, although flowering individuals have been observed with their spikes and scapes rising above the water surface.

Xyris correlliorum is apparently a very narrow endemic of relatively deep clear-water (17–20 m at their deepest points), sinkhole-solution lakes found on the southern portion of the LWR, in Highlands County. Vascular plant endemism on the LWR and central Florida endemic xeric vegetation types is well documented (Abrahamson et al., 1984; Christman & Judd, 1990; Dobson et al., 1997; Menges, 1999; Estill & Cruzan, 2001). *Xyris correlliorum* is the first endemic plant described from lacustrine habitats on the LWR, and the only one of the four vascular plants endemic to Highlands County (Bridges & Orzell, 2002) that does not occur in xeric habitats. This is noteworthy since some of the LWR lakes (Lakes Annie and Tulane) that presently exceed 18 m in depth have yielded continuous pollen cores that extend from the present to at least 13,000 years B.P. (Watts, 1975; Watts & Hansen, 1994; McDiffett, 1980). It is probable that southern LWR lakes, particularly the "fossil lakes" of Watts and Hansen (1994) contained surface water prior to 8,500 years B.P. (Watts & Stuiver, 1980; Watts & Hansen, 1988) at a time when an overwhelming majority of Florida's present-day lakes are presumed to have been dry (Watts & Hansen, 1988). Perhaps the long-term stability of these lakes accounts for the presence of *X. correlliorum* in these lakes, while it is absent from similar sinkhole-solution lakes found elsewhere in central Florida.

Paratypes. U.S.A. **Florida:** Highlands Co., in sedge-grass marsh along Lake Placid, Henry & Helen Price Memorial of Archbold Biological Station, 2 Sep. 1981, *Correll & Correll 52376* (FTG, USF); abundant, submerged, on E side of Lake Annie, 20 Aug. 1984, *Bourdieu & Desley s.n.* (ARCH); submerged and floating mats on SE shore of Lake Annie, 29 Mar. 1996, *Yahr, Orzell & Casado 233* (ARCH), 4 Sep. 1996, *Orzell, Bridges & Dean 25164* (ARCH, FLAS, USF), 5 Mar. 1996, *Orzell & Bridges 24250* (FLAS, FTG, USF); same as type locality, 4 Sep. 1996, *Orzell & Bridges 25163* (ARCH, BRIT, FLAS, FSU, FTG, MO, NY, TEX, USF); floating in clear, shallow water of sandy bottom lakeshore, E side of Grassy Lake, 16 Sep. 1996, *Orzell, Bridges & Yahr 25171* (FLAS, FTG, USF). Additional habitat and location data are available for Orzell & Bridges' collections from the authors.

The dichotomous key below covers all *Xyris* in Florida, including the new taxa.

KEY TO THE SPECIES OF *XYRIS* IN FLORIDA

1a. Keel of the lateral sepals shortly ciliate-scabrid, or if entire then the bract tips purple-tinged.
  2a. Plants relatively small, usually less than 30 cm tall, principal leaves usually less than 10 cm long, mature spikes less than 1 cm long at maturity.
    3a. Leaves filiform, with expanded brownish lustrous bases, usually exceeding sheath of scape . . . . . *X. isoetifolia* Kral
    3b. Leaves linear, bases not expanded, shorter than, equaling, or slightly exceeding sheath of scape.
      4a. Keel of lateral sepals linear to slightly curvate, remotely ciliate or entire; spikes broadly ovoid to subglobose, the bracts with maroon to purple-tinged, loose, often erose borders . . . . . *X. brevifolia* Michaux
      4b. Keel of lateral sepals strongly curvate, densely ciliate; spikes lance-ovoid to ovoid, the bracts entire, not purple-tinged, lacking erose borders.
        5a. Plants perennial; leaves ascending, equitant, green with distinct dark brown patch near base; fruiting spikes ovoid, blunt, somewhat two-edged from the strongly keeled outer bracts . . . . . *X. drummondii* Malme
        5b. Plants annual; leaves flabellately arranged, spreading to recurved, usually maroon; fruiting spikes often elongated and acute, not two-edged . . . . *X. flabelliformis* Chapman
  2b. Plants relatively large, usually 30 cm or more tall, principal leaves more than 10 cm long, mature spikes more than 1 cm long at maturity.
    6a. Seed lustrous, translucent, broadly ovoid; spike pale brown or tan, the scales loosely imbricate; plant bases pink, purple, or stramineous, with dark longitudinal striations on inner leaf bases; leaves shorter, broader, more flabellately spreading, abruptly tapered to tip; petal blades obovate, 0.6–0.7 mm long or more, opening in early morning, usually closed by mid day . . . . . *X. ambigua* Beyrich ex Kunth
    6b. Seed farinose, narrowly ellipsoid to ovoid; spike dark brown, the scales tightly imbricate; plant bases maroon, purple, dark brown, or red-brown; leaves narrowly linear, gradually tapering from the equitant base to tip; petal blades triangular-cuneate, 0.3–0.5 cm long, open at mid day.
      7a. Seed dark when mature; plant bases dark maroon to dark brown, densely caespitose on wet, mucky substrata; apex of scape conspicuously flattened, almost as broad as the spike; spike oblong-cylindrical, obtuse . . . . . *X. stricta* Chapman
      7b. Seed light-colored; plant bases maroon to maroon-brown, solitary or in small clumps on drier, clayey substrata; apex of scape somewhat flattened, but not nearly as broad as spike; spike narrowly ovoid to ellipsoid, slightly pointed . . . . *X. louisianica* E. L. Bridges & Orzell
1b. Keel of the lateral sepals irregularly lacerate or fimbriate, or if entire then the bract tips not purple-tinged.
  8a. Leaves narrowly linear to filiform, scarcely or not at all twisted, with expanded lustrous tan to brown harder bases, the plant base not bulbous or deeply seated in the substrate; plants usually densely caespitose; spikes ovoid and less than 1 cm long.
    9a. Leaves linear, flattened in cross section, and with a pale, hardened margin; scape usually narrower than the leaf blades; staminodia bearded . . . . . *X. elliottii* Chapman
    9b. Leaves filiform, terete to elliptic in cross section, without a paler margin; scape as broad as or broader than the leaf blades; staminodia beardless (unique in genus) . . . . *X. baldwiniana* Schultes
  8b. Leaves broader, twisted or straight, without expanded hardened brown bases, or if with brown bases, then the plant base bulbous or deeply seated in the substrate; plants caespitose or solitary; spikes narrowly to broadly ovoid, oblong, or ellipsoid, 0.4–3.5 cm long.
    10a. Keel of the lateral sepals long-fimbriate toward the tip, the fimbriate tip conspicuously exserted from the subtending bract (sometimes eroded and less conspicuous on older spikes).
      11a. Bases of leaves swollen, bulbous, dark lustrous brown; leaves strongly twisted; spikes narrowly ellipsoid or lance-ovoid; scape ridges smooth, not scabrous; petal blades white or yellow . . . . . *X. caroliniana* Walter
      11b. Bases of leaves soft, pale green, stramineous, or pink; leaves not twisted; spikes ellipsoid or oblong; scape ridges strongly scabrous; petal blades yellow . . . . . *X. fimbriata* Elliott
    10b. Keel of the lateral sepals lacerate, or if very shortly fimbriate then not exserted from the subtending bract.
      12a. Lateral sepals longer than and exserted from the subtending bracts, or if not exserted then plants rhizomatous.
        13a. Keel of the lateral sepal entire toward its base and lacerate toward the tip; ripe seeds ovoid or oblong, more than 0.5 mm long, with irregular, stout cross lines; plants generally larger, with the largest leaves more than 30 cm long and 5 mm broad . . . . . *X. smalliana* Nash
        13b. Keel of the lateral sepal tending to be ciliate toward its base and lacerate toward the tip; ripe seeds ellipsoidal, less than 0.6 mm long, with regular, thin cross lines, or cross lines obscure; plants generally smaller, with the largest leaves less than 25 cm long and 3 mm broad.
          14a. Plants annual, caespitose, without elongate scaly rhizomes; spikes 1–1.6 cm long; lateral sepals conspicuously exserted; petal blades slightly erose or shallowly serrate at tip; seeds with regular rectangular alveolae . . . . . *X. longisepala* Kral

14b. Plants perennial, forming dense mats from elongate scaly rhizomes; spikes (when mature) 2–3.2 cm long; lateral sepals only slightly if at all exserted; petal blades deeply lacerate at tip, the lobes 1.0–1.5 mm long; seeds with obscure alveolae . . . . . *X. correlliorum* E. L. Bridges & Orzell

12b. Lateral sepals shorter than, therefore hidden by, the subtending bracts except when spikes open and seeds are shed, plants never rhizomatous.

15a. Scapes flexuous, usually spirally twisted; upper portion of leaf blade conspicuously twisted; plant bases pink, purple, or dark brown.

16a. Plants forming rather dense clumps, scapes usually less than 50 cm tall; spikes diverging at a 10° to 20° angle from the apex of the scape; seed surface farinose . . . . . *X. calcicola* E. L. Bridges & Orzell

16b. Plants solitary or in small clumps, scapes usually more than 50 cm tall; spikes held vertically at the apex of the scape; seed surface not farinose.

17a. Base of plant deeply set in the substrate, without distinct outer scale leaves; leaf bases not noticeably expanded, thus the plant base not bulbous; leaves smooth, 2–4 mm wide; petal blades ca. 3 mm long . . . . . *X. chapmanii* E. L. Bridges & Orzell

17b. Base of plant shallowly set on the substrate, often with short, black outer scale leaves, leaf bases noticeably expanded to form short bulbous bases; leaves scabrous, 2–10 mm wide, or when smooth, then 5–10 mm wide; petal blades ca. 5 mm long.

18a. Leaf and scape surfaces smooth or scabrous only along the margins and ridges; petal blades obovate, white or yellow; seeds ovoid, 0.5–0.6 mm long . . . . . *X. platylepis* Chapman

18b. Leaf and scape surfaces prominently papillose or tuberculate-scabrid; petal blades suborbicular, yellow; seeds narrowly ovoid or narrowly ellipsoidal, ca. 1 mm long . . . . . *X. scabrifolia* R. M. Harper

15b. Scapes usually not flexuous, the scapes and leaf blades not conspicuously twisted; plant base color various.

19a. Summit of the scape distinctly flattened, usually more than 2 mm wide, broad relative to the spike; scape ridges few, the two most prominent comprising the flattened edges.

20a. The two principal scape ridges flattened and wing-like, their combined width (on fresh specimens) broader than the scape proper; fruiting spikes usually less than 1.5 cm long; seeds translucent, ovoid or ellipsoidal, less than 0.6 mm long . . . . . *X. difformis* Chapman

20b. The two principal scape ridges not flattened and wing-like, much narrower than the scape proper; fruiting spikes usually more than 1.5 cm long; seeds farinose, dark when ripe, fusiform or narrowly oblong, longer than 0.6 mm . . . . . *X. laxifolia* Martius var. *iridifolia* (Chapman) Kral

19b. Summit of the scape nearly terete or somewhat flattened, usually less than 2 mm wide, much narrower than the spike; scape ridges several, at least on the mid to lower portion of the scape.

21a. Seeds farinose or very dark; surfaces of leaves tuberculate-scabrid; leaves generally dull colored.

22a. Mature spikes ovoid, sharply acute; plants solitary or in small clumps; base of leaves a dark maroon to purple color, rarely pink . . . . . *X. floridana* (Kral) E. L. Bridges & Orzell

22b. Mature spikes ovoid to ellipsoid, acute to blunt; plants typically in large dense tufts; older leaves with dark-brown to gray bases, inner leaves with stramineous bases . . . . . *X. serotina* Chapman

21b. Seeds translucent, not farinose; surfaces of leaves smooth, or if sparsely tuberculate-scabrid, then broadly linear-curvate; leaves generally a bright yellow-green above the base.

23a. Plants annual, solitary or in small tufts; leaves linear, ascending, widely variable in size but usually more than 10 cm long; mature spikes obtuse, many-flowered; leaf bases usually stramineous (very rarely pink); petals often drying black and persisting on spike . . . . . *X. jupicai* Richard

23b. Plants perennial, usually in tufts, rarely solitary; leaves broadly linear-curvate, spreading, typically less than 10 cm long; mature spikes acute, with 10 or fewer flowers; leaf bases pink or purple, the bases spreading to expose the distinctly dark brown to purple-maroon base of scape; petals fugacious, not persisting on spikes . . . . . *X. curtissii* Malme

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A New Alpine Species of *Rhododendron* (Ericaceae) from New Guinea

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ABSTRACT. A new species of *Rhododendron* sect. *Vireya* from Mount Jaya, West Papua (Irian Jaya), Indonesia, is described and illustrated. The new species, *Rhododendron xenium* Gillian Brown & Craven, is related to *R. womersleyi* and *R. rubineiflorum*, of subsection *Euvireya*, based on scale and corolla features and leaf size. An identification key to *R. xenium* and related species in subsection *Euvireya* is provided.

Key words: Ericaceae, New Guinea, *Rhododendron*.

During the Carstensz Glaciers Expedition of 1971–1972 to New Guinea, the expedition biologist, G. S. Hope, made two collections of *Rhododendron* that subsequently were identified as *R. anagalliflorum* Wernham (L. Craven, *in herb. sched.* 1972, and H. Sleumer *in herb. sched.* 1973). Following the realization by Craven in 1979 that the name *R. anagalliflorum* was commonly being misapplied to an undescribed species, subsequently described as *R. rubineiflorum* Craven (Craven, 1980), his investigation of the Mount Jaya (Carstensz Mountains) specimens led to the conclusion that these probably represented a third species. The Mount Jaya specimens key out between *Rhododendron womersleyi* Sleumer and *R. anagalliflorum* in Sleumer's (1966: 568) classic treatment of section *Vireya* for Malesia. Differences between *R. anagalliflorum* and *R. rubineiflorum* are given in Craven (1980); in Sleumer's treatment specimens of the latter species key directly to *R. anagalliflorum*. Closer examinations of the two Mount Jaya specimens, and also of specimens of related species, have now confirmed that the former specimens represent a new species of the genus, described below as *Rhododendron xenium* Gillian Brown & Craven. In the account of the Carstensz Glaciers Expedition (Hope, 1976), the name *R. anagalliflorum* refers to the present new species.

Rhododendron xenium is placed in section *Vireya* subsect. *Euvireya* ser. *Linnaeoidea* Sleumer based on scale and corolla features and leaf size. It has the typical *Euvireya* scales, sessile, moderately lobed with a small variously colored center, and a corolla that is not salver-shaped; it is placed in series *Linnaeoidea* because of its small leaves, less than 1 cm by 0.6 cm (Sleumer, 1966). So far this species has only been recorded from Mount Jaya in the Indonesian province of West Papua (Irian Jaya) on the island of New Guinea. It appears to be most closely related to *R. womersleyi* and *R. rubineiflorum*; however, it differs from these two in numerous characters, outlined in Table 1. The most obvious differing characters are the length of the pedicel and style at anthesis, and the arrangement of the leaves. Other notable differences between the three species occur in the leaf apex shape and size, corolla shape, pedicel indumentum, perulae indumentum, stamen length, and staminal filament indumentum (Table 1).

The species epithet is derived from the Greek, *xenion*, gift to a guest, and is in reference to the long pedicel that presents the flower well above the foliage and thus facilitates feeding (and pollination) by nectarivorous birds that are presumed to visit the flowers of this species.

Rhododendron xenium Gillian Brown & Craven, sp. nov. TYPE: Indonesia. West Papua (Irian Jaya): limestone hill at S end of Carstensz Meadow, Mount Jaya (Carstensz Mountains.), alt. 3540 m, 13 Dec. 1971, *G. Hope, Carstensz Glaciers Expedition, ANU 10847* (holotype, CANB; isotype, BO). Figure 1.

A *R. womersleyi* pedicello longiore ((15.2–)19.5–31

Table 1. Species comparison table. Characters that differ among *Rhododendron xenium, R. womersleyi, and R. rubineiflorum* are shown and described.

Character	*R. xenium*	*R. womersleyi*	*R. rubineiflorum*
Leaf arrangement	scattered throughout a seasonal growth unit, not pseudowhorled	rather densely set along the distal part of the branchlet	in 3–5-merous pseudowhorls, rarely opposite
Leaf apex	short-acuminate	short-acuminate, subacute	acute to subacuminate
Leaf blade (mm)	(2–)3–8 × 2–4.5	5–8(–10, rarely 15) × 4–6(–7, rarely 10)	4.2–10 × 2–5
Pedicel			
—indumentum	scales and hairs	scales and hairs	scales only
—length at anthesis (mm)	(15.2–)19.5–31	8–12(–15)	6–6.5
Perulae	abaxial surface with scales (very sparse)	abaxial surface glabrous	abaxial surface glabrous
Calyx indumentum	scales and hairs	scales and hairs	scales
Calyx lobe lengths (mm)	0.7–1.5	0.6–1.3	1.3–1.5
Corolla curvature	slightly curved	slightly curved	straight
Corolla shape	campanulate	tubular	campanulate, broadly funnel-shaped campanulate
Corolla length (mm)	(15–)17–20	21–25.7	13–24
Corolla tube length (mm)	(9–)11–13.5	15.3–19.5	10–14
Corolla lobes	circular, circular-obovate	obovate-circular	obovate-wide oblong
Stamens	slightly longer than corolla tube	slightly longer than corolla tube	shorter than the corolla tube
Filaments	± hairy at the very base, glabrous above	glabrous, sometimes hairy in the proximal region	glabrous
Ovary dimensions (mm)	(2.7–)3–4 × ca. 2	4 × 1.5	2.2–3.5 × 1.5
Style length at anthesis (mm)	4.3–8.4	10.5–12	1.3–3

mm) et corolla longiore per anthesin, corolla campanulata et breviore ((15–)17–20 mm), et stylo breviore (4.3–8.4 mm) et *R. rubineifloro* foliis dispersis et lamina apice breviacuminata, perulis lepidotis persparsim, pedicello longiore et lepidoto pilosoque, corolla parum curvata, filamentis staminium pilosis, et stylo longiore differt.

Terrestrial shrub to ca. 20 cm tall. *Branchlets* moderately to densely lepidote (the scales in part persistent), terete to subterete. *Leaves* dispersed throughout a seasonal growth unit, not pseudowhorled; leaf blade ovate to ovate-elliptic (2–)3–8 × 2–4.5 mm, the apex shortly acuminate, the base broadly cuneate, the margin entire, slightly revolute, the midrib impressed above in lower 1/2–2/3, inconspicuous to just visible at the base of the upper surface, the veins inconspicuous, dark green above with the margin becoming brown, light brown beneath, initially lepidote on both surfaces becoming glabrous above with age (with visible impressions where the scales once were), persistently subdensely to laxly lepidote beneath (the scales brown, irregularly lobed and sessile); petiole 1–1.6 × 0.5 mm, flattened, lepidote on both surfaces. *Floral bud* unopened 4.5–6.5 × 2.5 mm; outer perulae ovate, acuminate at the apex, the abaxial surface very sparsely lepidote, the scales on the margin obscurely stalked; inner perulae the same as the outer perulae but narrower and shortly acuminate. *Pedicels* densely lepidote and hairy, (15.2–)19.5–31 × 0.6–0.9 mm at anthesis, 34–41 mm long in fruit. *Flowers* solitary, held erect, the perulae sometimes persistent. *Calyx* 5-lobed, ca. 2 mm diam., obtuse to rounded-obtuse, lepidote and hairy; lobes 0.7–1.5 × ca. 0.8 mm, the lobe margin with stalked scales. *Corolla* slightly curved campanulate, (15–)17–20 × 13–15.5 mm, bright red to red, waxy, moderately lepidote outside (extending over the entire tube and onto the lower middle part of the lobes), glabrous inside; tube (9–)11–13.5 × 3.5–5 mm (wide at the base) and 5.3–8 mm (wide at the throat); lobes circular to circular-obovate, 5.5–8.5 × 6.5–8.5 mm, overlapping at the base, rounded or retuse at the apex. *Stamens* 10, appearing unequal in length, ex-

Figure 1. *Rhododendron xenium* Gillian Brown & Craven. —A. Habit, flower orientation, and fruit dehiscence. —B. Inner perula (detail of the margin enlarged; stalks of scales not apparent). —C. Stamen. —D. Gynoecium. Drawn from *G. Hope ANU 10847* (CANB).

serted slightly from the corolla tube, stamens appear to be arranged equally around the mouth; filaments linear, 10–11 mm long, glabrous except for a few hairs at the very base; anthers broadly oblong, 1.2–1.6 × ca. 1 mm. *Disc* 10-lobed, ca. 0.6 mm high, 2–2.5 mm diam., with dense erect white hairs at the apex. *Ovary* subcylindrical, (2.7–)3–4 × ca. 2 mm, broadly tapering to the style, ribbed, densely covered in short white hairs over a subdense to lax layer of scales; style 4.3–8.4 × ca. 0.7 mm, hairy in the proximal 1/4–1/2, glabrous for the remainder, slightly shorter than the corolla tube; stigma capitate, 5-lobed. *Capsule* fusiform; immature fruits 14–14.5 × ca. 3.5 mm, purplish when dry, both hairy and lepidote (less dense than on the ovary); mature fruits ca. 20 mm long (excluding the style), brown, with no visible indumentum, the style persistent, when dehiscing the valves peeling back with only slight twisting at the base. *Seeds* not seen.

N.B. Floral measurements were determined by the method given in Argent et al. (1988).

Distribution and habitat. Known only from Carstensz Meadow at Mount Jaya in West Papua (Irian Jaya), New Guinea. Recorded as growing in crevices in peat in very griked limestone slopes [trenched limestone slopes due to solution along a

joint], and on rocky slopes on the forest margin. Altitude 3520–3540 m.

Paratype. INDONESIA. **West Papua (Irian Jaya):** limestone hill at S end of Carstensz Meadow, Mount Jaya (Carstensz Mountains.), alt. 3520 m, 13 Dec. 1971, *G. Hope, C.G.E., ANU 10840A* (CANB).

KEY TO *RHODODENDRON XENIUM* AND RELATED SPECIES

Couplet 2 of subsection *Euvireya* ser. *Linnaeoidea* in Sleumer (1966: 568) can be replaced with the following couplets that will permit specimens of *Rhododendron anagalliflorum*, *R. rubineiflorum*, *R. womersleyi*, and *R. xenium* to be identified.

2. Style at anthesis relatively short, i.e., approximately as long as the ovary or shorter. Calyx exclusively lepidote. Corolla straight, never curved.
   2a. Corolla funnel-shaped with elliptic lobes, white, flushed with purple from the base. Anthers 0.6 mm long . . . . . *R. anagalliflorum*
   2a. Corolla campanulate to broadly funnel-shaped campanulate with orbicular lobes, red to pink. Anthers 1.2–1.5 mm long . . . . . *R. rubineiflorum*
2. Style at anthesis at least two times as long as the ovary. Calyx both lepidote and hairy. Corolla slightly curved.
   2b. Pedicel shorter than the total length of the corolla at anthesis. Corolla tubular. Abaxial surface of perulae glabrous . . . . *R. womersleyi*
   2b. Pedicel longer than the total length of the corolla at anthesis. Corolla campanulate. Abaxial surface of perulae ± sparsely lepidote . . . . . *R. xenium*

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A New Species of *Casearia* (Flacourtiaceae) from Mexico

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ABSTRACT. *Casearia guevarana*, a new species of Flacourtiaceae from the coastal dunes of the Natural Reserve "El Morro de la Mancha," from the states of Veracruz and Tabasco, Mexico, is described and illustrated. Its affinities with the closely related species *C. aculeata* Jacquin and *C. obovata* Schlechtendal are discussed. This new species differs from its congeners by having broadly obtuse leaf apices, large, six-channeled fruits, and larger, more numerous seeds.

RESUMEN. Se describe como nueva a *Casearia guevarana* (Flacourtiaceae) de las dunas costeras de la Reserva Natural El Morro de La Mancha, Veracruz y Tabasco, México. Esta nueva especie está cercanamente relacionada con *Casearia aculeata* Jacquin y *C. obovata* Schlechtendal, de las que se distingue por presentar el ápice de las hojas ampliamente obtuso, frutos 6-acanalados y de mayor tamaño, con semillas más grandes y más numerosas.

Key words: *Casearia*, coastal, dunes, Flacourtiaceae, La Mancha, Mexico, Tabasco, Veracruz.

In 1998, during an inventory of trees and shrubs associated with an evergreen seasonal rainforest at the Nature Reserve and Center for Coastal Research at La Mancha (CICOLMA) in Veracruz, Mexico, a tree rarely seen in the middle stratum of the forest was sampled and reported. At the time, this tree was totally lacking reproductive structures, so that it was only possible to classify it with any certainty to the genus *Casearia* (Flacourtiaceae). However, during two years subsequent to this initial find, flowers (2000) and fruits (2001) were obtained. After having examined and compared vouchers of *C. aculeata* and *C. obovata* with those recently collected from the Natural Reserve of La Mancha, it was found that they corresponded to an undescribed species. Based upon this additional information, this specimen was considered to represent a new species. Its detailed description is reported below.

Casearia Jacquin is a pantropical genus of about 180 species of trees and shrubs. It is most diverse in (sub)tropical Central and South America, where some 75 species occur, including 8 in Veracruz. The genus is subdivided into six sections, the largest, and only one to occur outside of the Neotropics, is section *Casearia*. Three of the sections are represented in Veracruz: sect. *Crateria*, sect. *Piparea*, and sect. *Casearia*. Section *Casearia* is further divided into six informal groups, three of which occur in Veracruz, i.e. Nitidae, Aculeatae, and Decandrae.

The newly described *Casearia guevarana* has an undivided style, free stamens, and free interstaminal disc lobes. These characters place the species in *Casearia* sect. *Casearia*. The following characters place the species in section *Casearia*, group Aculeatae; an undivided style, at times obsolete, and capitate stigma; plants generally with spines, at times not present in herbarium vouchers; and stamens generally 8, flowers more or less tubular, base obtuse-truncate often slightly swollen just before flowering. Two other species of the Aculeatae group occur in Veracruz, *C. aculeata* and *C. obovata*.

Casearia guevarana Castillo-Campos & Medina, sp. nov. TYPE: Mexico. Veracruz: Nature Reserve "El Morro de la Mancha," Mun. Actopan, approx. 10 m, 24 May 2001, *G. Castillo C. 20801* (holotype, XAL; isotypes, ENCB, MEXU). Figure 1.

Arbor 3–6 m alta erecta spinis rectis munita vel inermis; foliis oppositis vel alternis, ellipticis vel ovatis, pe-

Figure 1. *Casearia guevarana* Castillo-C. & Medina. —a. Branch with infructescence. —b. Inflorescence in bud. —c. Detail of the inflorescence with bracts. —d. Detail of an open flower in natural state. —e. Immature fruit. —f. Detail of fruit apex. —g. Mature fruit. —h. Open fruit. —i. Valve. —j. Seed. (Based on the paratype *Castillo 19902*.)

tiolatis, 2.0–8.8 cm longis, 1.4–4.2 cm latis. Flores albi perfecti pedicellati, pedicellis ad dimidium articulatis; sepalis 5 ovatis, 5–6 mm longis, 2.2–2.5 mm latis; staminibus 8. Fructus capsularis subglobosus, juventute 3-costatus, maturitate 6-canaliculatus.

Perennial tree or shrub; 3–6 m high; trunk about 20 cm diam.; bark smooth; older branches brown; prickles brown to ash-gray, darker at prickle apex; in young branches, frequently ending in a prickle, or prickle-less, pubescent, lenticellate; prickle straight (when present), 0.7–1.7 cm long, 1–2.5 mm wide at base, basal half lenticellate, apex acute. Leaves alternate, distichous, simple, petiolate, obovate-elliptic, 2–8.8 cm long, 1.4–4.2 cm wide, coriaceous; base attenuate, cuneate, apex broadly obtuse, frequently shallow-emarginate; margin crenate with 3 to 10 teeth per side, upper and lower surface lustrous with a few scattered hyaline hairs on the underside, glabrescent; venation brochidodromous, central vein pubescent on both surfaces, more densely so on the upper surface, lateral veins 3 to 7, tertiary venation reticulate. Petiole 2–6 × 0.5–0.8 mm, pubescent on upper and underside. Flowers bisexual, 1 to 11 (frequently 3) in axillary peduncled fascicles, white. Bracts ovate, 0.5–1.1 × 0.5–1.0 mm, pubescent, chartaceous, with acute apex and entire margin, yellowish when young, turning to light green and then light brown when mature. Pedicels 5–11 × 0.5 mm, articulate near middle, glabrescent. Sepals 5, imbricate, 5–6 × 2.2–2.5 mm, spreading, ovate, with obtuse apex and entire margin, outside glabrescent, inside glabrous, deciduous although frequently persistent in immature fruits. Stamens 8, filaments 3.5 mm long, flattened, glabrous; anthers 0.5 × 0.5 mm. Disc lobes alternate with stamens, villous. Ovary ovoid, villous; style undivided; stigma capitate, 0.6–0.8 mm long. Fruit capsular with septicidal dehiscence, subglobose, 3-ribbed when immature, 6-channeled when mature (3 prominent channels, 3 shallow), 9–14 × 7–10 mm, green when young and yellowish when mature, purple at base and along the more prominent channels, splitting into 3 valves, retrorse, 5–10 × 5–7 mm; endocarp red at maturity, the inner surface of each valve with 1–7 small white spots. Seeds 16–21, yellow to orange at maturity, brilliant, usually ovate, angular, 3–6 × 2–4.5 mm, base truncate; seed coat reticulate, completely covered by aril, aril mucilaginous, orange with small white spots.

Phenology. *Casearia guevarana* flowers and fruits between May and November, and its flowering and fruiting periods are brief. Flowers and fruits are fragile, detaching easily as branches are moved by the wind. Young fruits are ribbed, but at maturity these are lost and substituted by channels or longitudinal depressions. These characters are lost in dried specimens because well-developed fruits open during the drying process.

Habitat. *Casearia guevarana* is found in evergreen seasonal rainforest along the coastal dunes of El Morro de la Mancha in central Veracruz, Mexico. A rare tree forming part of the middle stratum of the tropical deciduous forest, it is associated with *Brosimum alicastrum* Swartz, *Bursera simaruba* (L.) Sargent, *Cedrela odorata* L., *Ehretia tinifolia* L., *Enterolobium cyclocarpum* (Jacquin) Grisebach, *Exostema mexicanum* A. Gray, *Ficus cotinifolia* Kunth, *Ginoria nudiflora* (Hemsley) Koehne, *Gyrocarpus jatrophifolius* Domin, *Tabebuia rosea* (Bertoloni) DC., and *Nectandra salicifolia* (Kunth) Nees.

Distribution. *Casearia guevarana* has a limited distribution, being found in just two localities: one in the state of Veracruz and the other in the state of Tabasco. Both sites occur on the coastal plain of the Gulf of Mexico in evergreen seasonal rainforest at above sea level.

Etymology. The specific epithet alludes to Sergio Guevara Sada, paying particular homage to his research and enthusiasm in consolidating and promoting the Nature Reserve and Center for Coastal Research at La Mancha (CICOLMA), Veracruz, Mexico.

Discussion. *Casearia guevarana* is closely related to *C. aculeata* and *C. obovata*, with which it shares certain morphological characteristics, especially the presence of prickles, leaf form, petiole length, pedicel articulation, number of stamens, pubescence of disc lobules, and ovary and flower color. *Casearia guevarana* is distinguished from *C. aculeata* and *C. obovata* by its glabrous, lustrous leaves; broadly obtuse leaf apices; larger, six-channeled fruit; and larger, more numerous seeds (Table 1). *Casearia aculeata* and *C. obovata* are similar, differing only in leaf form, apex, and pubescence (Nee, 1999). *Casearia obovata* and *C. guevarana* are endemic to Mexico, whereas *C. aculeata* has a much wider distribution, from Sinaloa and Tamaulipas in northern Mexico to South America and the Antilles (Sleumer, 1980; Nee, 1999).

Paratypes. MEXICO. **Tabasco:** km 21 along the highway that runs from Paraíso to La Barra de Tupilco, Mun. Paraíso, *M. A. Magaña A. 482* (XAL); km 1.7 along the highway from Nicolás Bravo-Mecoacan to Aquíles Serdán, Mun. Paraíso, *Cowan 3205* (ENCB). **Veracruz:** nature reserve at El Morro de La Mancha, Mun. Actopan, *G. Castillo C. 19902, 19238* (ENCB, MEXU, XAL).

Acknowledgments. Our sincerest thanks are extended to Jerzy Rzedowski for the Latin description

Table 1. Similarities and differences between *Casearia guevarana*, *C. aculeata*, and *C. obovata* (Sleumer, 1980; Nee, 1999).

		Casearia guevarana	*Casearia aculeata*	*Casearia obovata*
Leaf	Shape	obovate, elliptic	oblong, ovate-oblong, obovate	obovate
	Pubescence	glabrous, except on the central vein	pubescent to glabrous	pubescent
	Length (cm)	2.0–8.8	5–8	3.5–9.0
	Width (cm)	1.4–4.2	3–4	2–5
	Apex	broadly obtuse, frequently emarginate	abruptly attenuate	abruptly acuminate
	Base	attenuate, cuneate	acute to obtuse	acute to obtuse
Petiole	Length (mm)	2–6	2–6	3–10
Flower	Number	1 to 11, frequently 3	5 to 10	few
	Color	white	yellow-green, white	green-white
	Stamens	8	8	8
	Filament	glabrous	glabrous	glabrous
	Disc lobed	villous	villous	villous
	Ovary	villous	villous	pubescent
Pedicel	Length (mm)	5–11	4–6	3–8
	Articulation	present	present	present
Fruit	Shape	subglobose, 6-channeled	subglobose, obtusely triangular	subglobose
	Length (mm)	9–14	5–6	6–8
	Width (mm)	7–10	5–8	6–8
Seed	Number	16–21	3–10	few
	Length (mm)	3–6	4	2.5
	Shape	ovoid to angular	ovoid to angular	ovoid to angular

of *Casearia guevarana* and for his comments on the manuscript. Thanks are also given to Francisco Lorea H. and Andres P. Vovides for their sound suggestions on the manuscript, Edmundo Saavedra for preparing the illustration, to the herbaria MEXU and ENCB for loan of specimens used in this research, and to Dan Bennack for translating the original article from Spanish to English. This research was funded by CONABIO (L-228) and Instituto de Ecología, A. C. (904–14).

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A New Species of *Tovomita* (Clusiaceae) from Amazonian Venezuela and Peru

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ABSTRACT. *Tovomita stergiosii*, a new species of Clusiaceae from the Venezuelan and Peruvian Amazonian region, is described, illustrated, and compared to its closest relative, *T. brasiliensis* (Martius) Walpers from Brazil, from which it differs in leaf shape, pedicel length, floral parts, and fruit shape.

Key words: Amazonia, Clusiaceae, Peru, *Tovomita*, Venezuela.

Tovomita Aublet is a Neotropical genus of about 45 species, most of them occurring in Amazonian Brazil, Peru, and Venezuela. They are small laticiferous trees or shrubs with stilt roots, occurring in several habitat and forest types, but usually in coastal rain forests in the Amazon. The genus is placed in Clusiaceae by the usually unisexual flowers (plants monoecious, dioecious, or polygamous) in terminal cymose inflorescences, with flower buds completely enclosed by the outer sepals, which are nearly completely fused and splitting lengthwise into 2 to 4 opposite sepals; the decussate leaves, with a margined pit in the axillary part of the petiole; the fruit a fleshy drupaceous capsule with styles often distinct, dehiscent septicidally to the base, and often brightly colored within, and the seeds large, 1 per locule, enveloped by a fleshy venose aril.

In a recent treatment of the genus *Tovomita* (Cuello, 1998), the name of *Tovomita* aff. *brasiliensis* (Martius) Walpers was tentatively used based on a close match of material from the flora area to the description and illustration for that species in *Flora Brasiliensis* (Engler, 1858: t. 97, f. I). However, examination of additional specimens from Venezuela and Peru revealed considerable differences from the type material for that name, indicating that this material certainly is of an undescribed species. A name, description, and illustration are provided here.

Tovomita stergiosii Cuello, sp. nov. TYPE: Venezuela. Amazonas: Cuenca del Río Casiquiare, selvas y sabanas de arenas blancas del caño Tiramoni (entre los caños Atamoni y Momoni), con entrada hacia tierra firme. 10–22 Feb. 1989 (fl), *Basil Stergios, Klaus Kubitzki, Gerardo Aymard & Emidio Melgueiro 13161* (holotype, PORT; isotypes, HBG not seen, MO, NY, TFAV not seen, VEN not seen). Figure 1.

Haec species *T. brasiliensi* affinis, sed ab ea foliorum lanceolatorum basi attenuatorum apice acuminatorum usque caudatorum costa supra elevata subtus impressa (non prominente) ac nervis lateralibus subtus obsolescentibus (non elevatis), pedicellis 9–11(–20) mm longis, gemmis floralibus masculis mucronatis, sepalis 4 exterioribus orbiculatis, petalis interioribus apice breviter dilatatis, staminum filamentis crassiusculis quadratis atque fructu pyriformi in stylum 1 mm vix attingentem desinente differt.

Presumed monoecious treelet, 3–8 m tall. Branches terete, glabrous. Latex whitish, wood with sweet aroma. Leaves opposite, decussate, glabrous on both surfaces, clustered toward upper parts of branches with internodes (3–)4–8(–11) mm long; the petioles plane, 3–7(–12) mm long; the blades membranous, lanceolate to elliptic-lanceolate, (3–)4–10 × (0.5–)1–2.5 cm, attenuate at base, acute-acuminate to caudate at apex, the apex 5–15 mm long, base 1.5–2 mm wide, margin thinly revolute, main nerve elevated in upper surface, impressed beneath, lateral veins inconspicuous in mature leaves, slightly visible in younger leaves but not prominent, less than 3 mm apart. Inflorescences cymoid, terminal, 1.5–3 cm long, usually divided into 3 branches near the base, but secondary flowers of lateral branches caducous, leaving each branch 1-flowered and appearing as a simple dichasium, peduncle 1–6 mm long, terminal internode 6–20 mm long, internodes of lateral branches 3.5–20 mm long; pedicels slender, 9–11(–20) mm long in primary flowers. Bracts caducous, not seen. Flower buds ovoid, 4–5 × 2.5–3 mm, the staminate buds mucronulate, apex ca. 0.5–1 mm long, the pistillate buds slightly shorter and broader. Sepals 4, the 2 external sepals green, coriaceous, fused up to the

Figure 1. *Tovomita stergiosii* Cuello. Habit with details of flowers and leaves. —A. Habit and staminate flowering branch. —B. Staminate flower bud. —C. External sepals. —D. Internal sepals. —E. External petals. —F. Internal petals. —G. Stamens. —H. Pistillode. —I. Pistillate flower bud. —J. External sepals. —K. Internal sepals. —L. External petals. —M. Internal petals. —N. Staminodes. —O. Pistil. —P. Branch bearing young fruits. —Q. Detail of leaf margin from abaxial view. —R–V. Leaf shapes and sizes. (A based on *Colella et al. 2016*, PORT; B–H and V based on *Stergios et al. 13161*, PORT; I–R based on *Rimachi 7616*, MO; S based on *McDaniel & Rimachi 20466*, MO; T based on *Aymard & Delgado 8423*, PORT; and U based on *Castillo & Camaripano 8362*, PORT.)

middle, 4–5 × 3–4 mm, broadly oblong to orbicular, cymbiform, truncated at base, the outer of the two mucronulate in staminate flowers; the 2 internal sepals petaloid, imbricate, broadly oblong, 3–5 × 2–3 mm, the inner one hooded, narrower than the outer, apiculate in staminate flower, apex ca. 1 mm long. Petals 4, varied in shape, free and distinct in bud, white, 3–5 × 1.5–2 mm, decussate, the 2 external petals oblong, rounded to truncate or sinuolate at apex, the 2 internal petals contracted at 1/3 the distance from the apex and shortly widened at apex, the claw 2.5–3 mm long, 1.5–2 mm wide, the blade 1–1.5 mm long, 3–4 mm wide. Stamens ca. 20, filaments moderately thick, tetragonous, ca. 0.5 mm wide, 2.5–3.5 mm long, thecae obliquely attached, 0.5–1 mm long. Staminodes ca. 20, 3.5–4 mm long. Pistil in female buds 2–2.5 mm long, shortly urceolate, wider and slightly angulate at base, ovary 4-celled, styles 4, distinct, 0.5–0.6 mm long, stigmas cordate to rounded, 0.5–0.7 mm diam. Pistillode in staminate buds very small, ca. 0.5 mm long. Fruit a fleshy septicidal capsule, pyriform when still closed, 1.7–2.2 × 0.7–1.4 cm, green externally, pink within, estipitate, with 4 short, persistent, crowned styles 0.8–1 mm long, stigmas rounded in fruit, 0.5–0.7 mm diam. Seeds reniform, arillate, 7.5–9 mm long, 4–5 mm wide.

Distribution and ecology. *Tovomita stergiosii* is a small tree known from shrubby white-sand savannas and edges of inundated lowland forest along blackwater rivers, between 90 and 250 m elevation in Venezuelan and Peruvian Amazonia. The new species is known in Peruvian highland Quechua as "chullachaqui caspi" (*Rimachi 7615,* MO).

Tovomita stergiosii is most similar to *T. brasiliensis* (Martius) Walpers from Brazil, French Guiana, and Colombia (Martius, 1826; Walpers, 1842; Engler, 1858) with regard to habit and leaf features. Both are small trees with terete branches, and both have small, membranous leaves on short internodes. However, *T. stergiosii* differs in having lanceolate leaves rather than oblong-elliptic leaves, with an attenuate rather than acute base and an acute-acuminate to caudate rather than obtuse apex. Additionally, in *T. stergiosii* the main leaf nerve is impressed and not prominent, and lateral nerves are slightly visible on the undersurface. In contrast, *T. brasiliensis* has leaves with a prominent main nerve and its lateral nerves are slightly raised beneath. Furthermore, the flower buds in the new species are mucronulate in staminate flowers, with four sepals, the outer sepal orbicular-mucronulate, the two inner petals shortly widened at the apex. In *T. brasiliensis,* the flower buds are rounded at the apex, not mucronulate, with only two ovate-obtuse sepals, and petals obovate-oblong and obtuse. Also, the new species differs by its longer pedicels, 9–11(–20) mm long, less numerous stamens (ca. 20) with moderately thick and quadrangular filaments, and a pyriform fruit with short styles ca. 1 mm long. *Tovomita brasiliensis* has shorter pedicels, 6–8 mm long, ca. 50 stamens with flattened, filiform filaments, and an obovate fruit with longer, persistent styles up to 3 mm long.

Among specimens examined of *Tovomita stergiosii,* a variation in the sizes and shapes of leaves was noted, especially in the shape of the leaf apices, which can vary from acute to acuminate in Venezuelan and Peruvian specimens and even to caudate in some of the Peruvian specimens.

This species is named in honor of Basil Stergios (1940–) from PORT, in recognition of his enthusiasm for botanical exploration in Venezuela and for collecting the type specimen.

Paratypes. VENEZUELA. **Territorio Federal Amazonas:** Atabapo, Alto Río Orinoco, Caño Tama Tama, 2 km al E de Tama Tama, 3 Mar. 1990 (fr), *G. Aymard & L. Delgado 8423* (MO, PORT, VEN not seen); Casiquiare, Río Casiquiare, Laguna de Paciva y sus alrededores, 8 Feb. 1991 (fl, fr), *M. Colella, J. Velázco, E. Guayamare & S. Camico 2016* (NY, PORT); Río Sipapo, cerca de Cerro Pelota, 20 Feb. 2001 (fr), *A. Castillo & B. Camaripano 8362* (PORT, VEN not seen). PERU. **Loreto:** Maynas, Iquitos, Río Nanay, Quebrada de Momón, un poco arriba del caserío de San José, Aug. 1984 (fl, fr), *M. Rimachi 7616* (MO); Río Nanay, two bends below entrance to Mapa Cocha, 14 Jan. 1976 (fl), *S. McDaniel & M. Rimachi 20466* (MO); vicinity of Iquitos (collection data lost), 1977 (fl), *J. Revilla 3610* (MO); Río Mamón near Río Nanay, 1 Sep. 1972 (fl), *T. Croat 19887* (MO).

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New and Reconsidered Mexican Acanthaceae X. Flora del Bajío Region

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ABSTRACT. Three new species (*Carlowrightia venturae*, *Justicia zamudioi*, and *Tetramerium carranzae*) and a new combination (*Mirandea hyssopus* based on *Rhytiglossa hyssopus* Nees) are proposed for the acanthaceous flora of the region in central Mexico covered by the *Flora del Bajío y de Regiones Adyacentes*. Morphological and palynological characters are used to distinguish these taxa from their Mexican congeners. Studies of Acanthaceae in this region reveal the presence of 59 species (5 endemic) in 18 genera there.

RESUMEN. Tres especies nuevas (*Carlowrightia venturae*, *Justicia zamudioi*, y *Tetramerium carranzae*) y una combinación nueva (*Mirandea hyssopus* basada en *Rhytiglossa hyssopus* Nees) se proponen para la flora de acantáceas de la región de México central cubierta por la *Flora del Bajío y de Regiones Adyacentes*. Los caracteres morfológicos y palinológicos se utilizan para distinguir estos taxa de sus congéneres mexicanos. Los estudios de Acanthaceae en ésta región revelan la presencia de 59 especies (5 endémicas) en 18 géneros allí.

Key words: Acanthaceae, *Carlowrightia*, *Justicia*, Mexico, *Mirandea*, pollen, *Tetramerium*.

The relatively high and flat region located in the southern extremity of central Mexico's Altiplano, comprising portions of the states of Guanajuato, Michoacán, and Querétaro, is commonly referred to as "el Bajío" (Rzedowski & Calderón de Rzedowski, 1987). An amplification of this region, including all of Guanajuato and Querétaro as well as much of northern Michoacán, is the subject of the *Flora del Bajío y de Regiones Adyacentes*, a project of the Instituto de Ecología in Pátzcuaro, Michoacán (Calderón de Rzedowski & Rzedowski, 1991). This amplified region comprises about 50,000 square kilometers, contains considerable topographic relief, and is estimated to have more than 5500 species of plants (Calderón de Rzedowski & Rzedowski, 1991). Portions of the amplified region, especially in northern Guanajuato and adjacent Querétaro, remained botanically unexplored until the late 1980s and 1990s. Extensive field activities associated with the ongoing floristic project have resulted in approximately 55,000 plant collections since 1985 when the project was initiated (J. Rzedowski, pers. comm.). Studies of these collections have revealed numerous undescribed species and distributional range extensions in various taxa (e.g., Calderón de Rzedowski, 1991; Calderón de Rzedowski & Rzedowski, 1997; Rzedowski & Calderón de Rzedowski, 1995, 1997, 1998a, 1998b; Daniel, 1999).

In this report three new species and a new combination are proposed for the acanthaceous flora of the amplified Bajío region. Studies of Acanthaceae in this region to date reveal the presence of 59 species in 18 genera (Daniel, unpublished). Sixteen of these genera are native to the region and five species (including those treated here) appear to be endemic there. An account of the family in the Bajío region is being prepared for the flora noted above.

Carlowrightia venturae T. F. Daniel, sp. nov. TYPE: Mexico. Guanajuato: Mpio. Victoria, Cerro de la Luz, camino a Xichú, 1800 m, 26 July 1991, *E. Ventura V. & E. López P. 9336* (holotype, IEB; isotype, CAS). Figure 1.

Herbae perennes decumbentes usque ad 1.5 dm altae. Caules juniores bisulcati, pubescentes trichomatibus eglandulosis. Folia petiolata, petioli usque ad 3 mm longi, laminae lanceolato-ovatae vel ovatae, 10–22 × 2.8–8 mm, 2.1–3.8-plo longiores quam latiores. Dichasia redacta, 1-flora, sessilia in axillis bractearum. Calyces 3.7–6 mm longi, extus glandulosi. Corollae subactinomorphae, azurae, 7–9.5 mm longae. Capsulae 9–10 mm longae, extus pubescentes. Semina 3.5–3.8 × 3.3–3.5 mm, testae tuberculatae ad margines dentatae.

Decumbent perennial herbs to 1.5 dm tall from stout woody caudices. Young stems bisulcate, ± bifariously pubescent with retrorse eglandular trichomes 0.05–0.1 mm long, trichomes concentrated in (or restricted to) 2 lines. Leaves petiolate, petioles to 3 mm long, blades lance-ovate to ovate, 10–22 × 2.8–8 mm, 2.1–3.8 times longer than wide, truncate to rounded at base, acuminate at apex, surfaces with several orders of venation prominent,

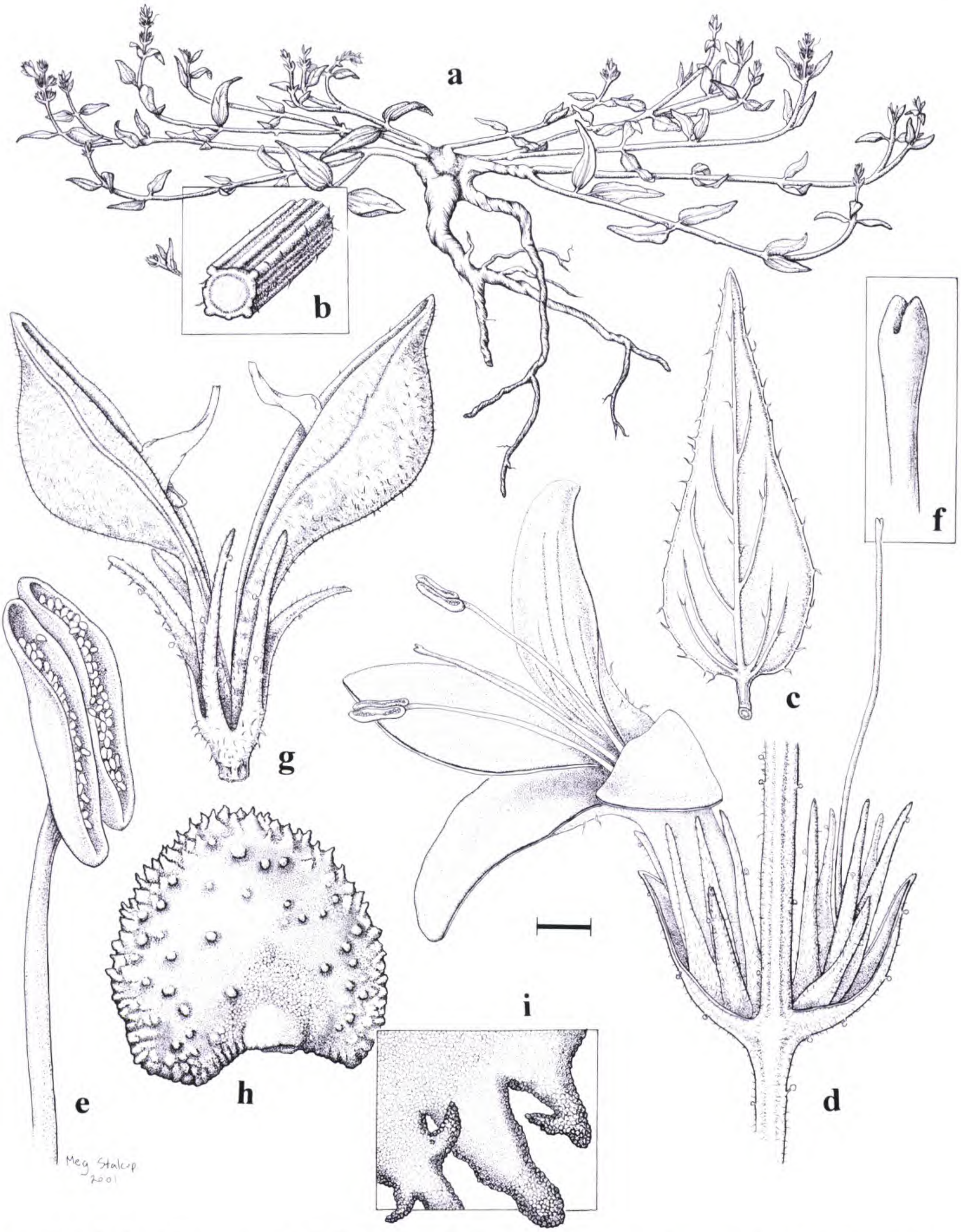

Figure 1. *Carlowrightia venturae* T. F. Daniel. —a. Habit. —b. Enlargement of section of young stem. —c. Leaf. —d. Inflorescence node with flower. —e. Distal portion of stamen. —f. Distal portion of style. —g. Capsule and calyx. —h. Seed. —i. Enlargement of seminal tubercles. a–c from *Ventura & López 7399*; d–i from *Ventura & López 9336*. Drawn by M. Stalcup. Scales: a = 15 mm; b = 2.6 mm; c = 1.5 mm; d = 1 mm; e = 0.2 mm; f = 0.3 mm; g = 1.1 mm; h = 0.6 mm; i = 0.04 mm.

pubescent with erect to flexuose to antrorse eglandular trichomes (these mostly restricted to major veins on abaxial surface) to nearly glabrate, margin flat, ciliate with understory of erect to flexuose to antrorse eglandular, subglandular, and glandular (sometimes sparse or absent) trichomes to 0.1 mm long and an overstory of flexuose to antrorse eglandular trichomes to 0.6 mm long. Inflorescence of terminal pedunculate dichasiate spikes to 5 cm long (including peduncles and excluding flowers), axillary spikes sometimes present in axils of distalmost leaves as well, peduncles to 29 mm long, pubescent like young stems or with trichomes becoming somewhat more evenly disposed, rachis ± evenly pubescent with erect eglandular and glandular (sometimes sparse) trichomes 0.05–0.2 mm long; dichasia opposite, sessile, 1-flowered. Bracts lance-subulate, 2.8–5.5 × 0.8–1.3 mm (proximalmost bracts sometimes subfoliose and larger, i.e., up to 9 mm long and 2 mm wide), abaxial surface pubescent like rachis. Bracteoles linear to lance-subulate, 2–3 × 0.5–0.6 mm, abaxial surface pubescent like bracts. Flowers sessile to subsessile (i.e., borne on pedicels to 0.5 mm long). Calyx 3.7–6 mm long, lobes subulate, 2.9–5 mm long, abaxially pubescent like rachis. Corolla subactinomorphic, blue, 7–9.5 mm long, externally pubescent with erect to flexuose to antrorse eglandular trichomes 0.1–0.2 mm long, tube 3–3.5 mm long, 1.3–1.7 mm diam., upper lip 4–5 mm long, 0.8–1 mm wide, lower lip 4–7 mm long, lobes homomorphic, 3.5–6 × 1–2.3 mm. Stamens 5–6 mm long, filaments bluish, glabrous distally, pubescent near base with retrorse eglandular trichomes, thecae yellowish, 0.9–1.1 mm long. Style 4–7 mm long, glabrous, stigma lobes 0.2 mm long. Capsule 9–10 mm long, pubescent with erect to retrorse eglandular trichomes 0.05–0.1 mm long, stipe 4 mm long, head subspheric, 6 mm long. Seeds 2 (to 3) per capsule, flat to planoconvex, 3.5–3.8 × 3.3–3.5 mm, surfaces tuberculate with conic projections, margin dentate, teeth often with retrorse barbs.

Phenology. Flowering and fruiting in July and October.

Distribution and habitat. Known only from northeastern Guanajuato (Fig. 2); plants occur in grasslands at 1800 m.

Twenty-six species of *Carlowrightia* are now recognized, with 24 of them occurring in Mexico (Daniel, 1983, 1988; Daniel & Wasshausen, 1993; Ezcurra, 1994). Pollen of *C. venturae* (Fig. 3) is 3-colporate and 6-pseudocolpate (with pairs of pseudocolpi sometimes fusing and forming pseudocolpal ellipses in mesocolpia). It resembles that of other species of the genus (Daniel, 1998).

Carlowrightia venturae is known only from the state of Guanajuato in central Mexico. Two other species of the genus, *C. parviflora* (Buckley) Wasshausen and *C. neesiana* (Schauer ex Nees) T. F. Daniel, are known from Guanajuato. They can be distinguished from *C. venturae* by the following key.

KEY TO SPECIES OF *CARLOWRIGHTIA* IN GUANAJUATO

1a. Young stems terete to quadrate, pubescent with glandular and eglandular trichomes; corolla pseudopapilionaceous, white within, (11–)15–19(–26) mm long, lower central lobe conduplicate-keeled; thecae maroon; capsule 10–16 mm long, head distinctly flattened laterally . . . . . *C. neesiana*

1b. Young stems bisulcate with 4 prominent ridges, pubescent with eglandular trichomes only; corolla subactinomorphic, blue within, 6.5–11(–13) mm long, lower central lobe not conduplicate-keeled; thecae yellow; capsule 8–10.5 mm long, head spherical to partially flattened.

2a. Capsule pubescent; plants prostrate-decumbent; leaf margin flat . . . . . *C. venturae*

2b. Capsule glabrous; plants erect to spreading; leaf margin revolute . . . . . *C. parviflora*

Using the key to sections provided by Daniel (1983), *Carlowrightia venturae* belongs to section *Carlowrightia*. It appears to differ from other species in that section only by usually having two rather than four seeds per capsule. Within section *Carlowrightia*, *C. venturae* differs from *C. linearifolia* (Torrey) A. Gray by its bisulcate (vs. multistriate) stems with bifariously (vs. evenly) disposed trichomes, lance-ovate to ovate (vs. linear) leaves, and dentate (vs. entire) seed margin, and it differs from *C. parviflora* and *C. ovata* A. Gray by its pubescent (vs. glabrous) capsules. *Carlowrightia venturae* appears most similar to *C. hapalocarpa* B. L. Robinson & Greenman; both species have bisulcate stems with bifariously disposed trichomes and pubescent capsules. These two species can be distinguished by the following couplet:

1a. Plants prostrate-decumbent; young stems pubescent with trichomes 0.05–0.1 mm long; leaves 2.8–8 mm wide, 2.1–3.8 times longer than wide, truncate to rounded at base; bracts lance-subulate, 0.8–1.3 mm wide; bracteoles linear to lance-subulate, 2–3 × 0.5–0.6 mm; calyx 3.7–6 mm long; corolla 7–9.5 mm long, upper lip 4–5 mm long, 0.8–1 mm wide; thecae 0.9–1.1 mm long; style 4–7 mm long; capsule 9–10 mm long; seeds usually 2 per capsule, 3.5–3.8 mm long . . . . . *C. venturae*

1b. Plants erect to spreading; young stems pubescent with trichomes 0.2–1.5 mm long; leaves 5–30 mm wide, 1–2 times longer than wide, subcordate to cordate at base; bracts triangular, 1.5–2

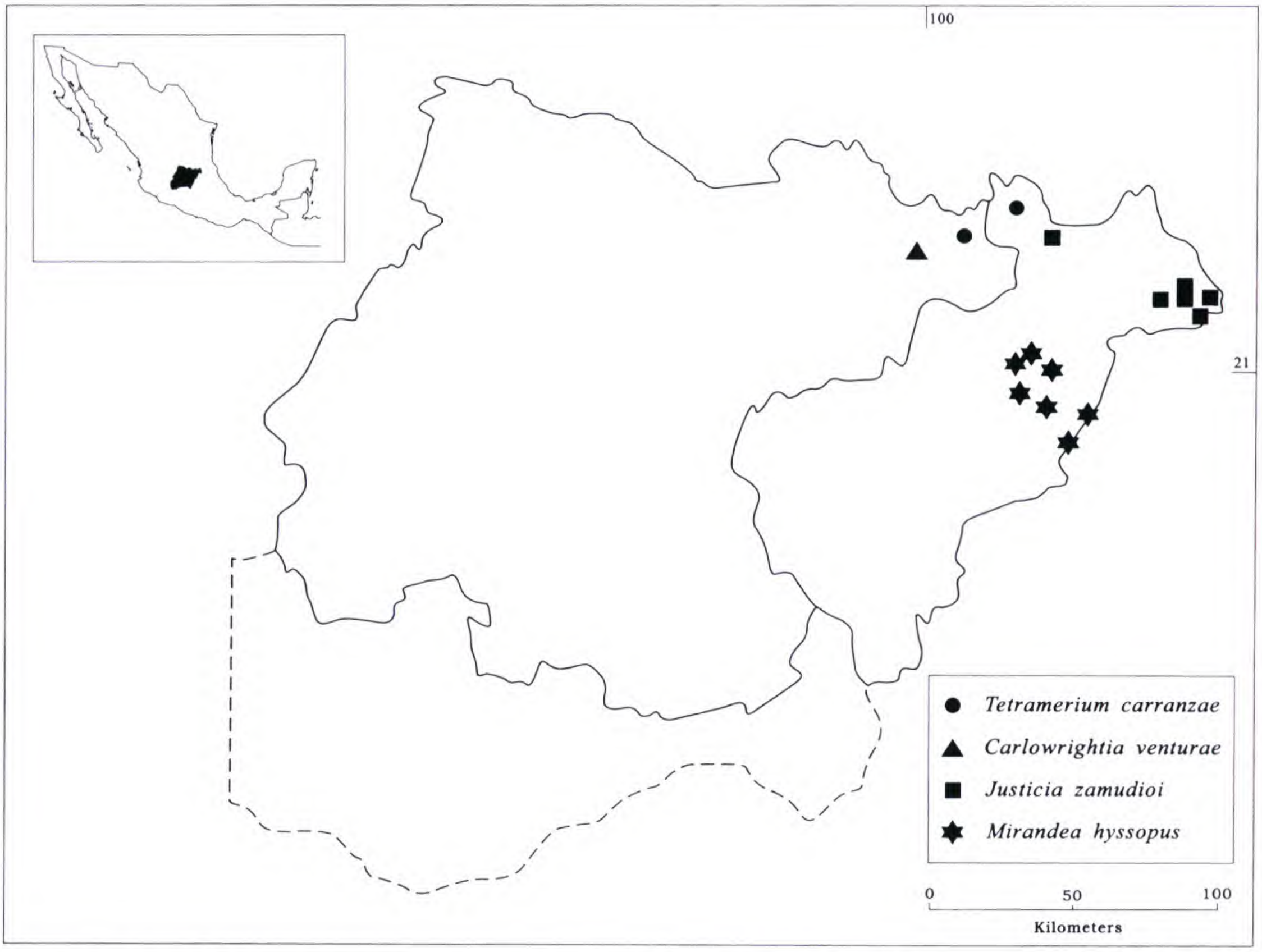

Figure 2. Map of the region covered by the *Flora del Bajío* (including Guanajuato, Querétaro, and northern Michoacán) showing the distributions of *Carlowrightia venturae*, *Justicia zamudioi*, *Mirandea hyssopus*, and *Tetramerium carranzae*.

mm wide; bracteoles triangular, 1–1.2 × 0.7–1 mm; calyx 2.5–3.5 mm long; corolla 9–12 mm long, upper lip 6.5–9 mm long, 2–3 mm wide; thecae 1.3–1.6 mm long; style 7.5–9 mm long; capsule 10.5–11.5 mm long; seeds usually 4 per capsule, 4–4.8 mm long . . . . . *C. hapalocarpa*

Some of these putative distinctions may reflect a lack of sufficient data on character variation in *C. venturae*, which is known from only two collections. However, the number of differences between *C. venturae* and *C. hapalocarpa* suggests that the former species should be treated as distinct from the latter.

This species is named for one of its collectors, Emma Ventura V., who, with E. López P., has collected many fine specimens of Acanthaceae from Guanajuato (Rzedowski, 1997).

Paratype. MEXICO. **Guanajuato:** Mpio. Victoria, La Luz, 6 km S de Cañada de Moreno, 3 Oct. 1989, *E. Ventura V. & E. López P. 7399* (CAS, IEB).

Justicia zamudioi T. F. Daniel, sp. nov. TYPE: Mexico. Querétaro: Mpio. Landa, 6 km E de La Vuelta, 1400 m, 21 Sep. 1988, *S. Zamudio 6814* (holotype, IEB; isotype, CAS). Figure 4.

Herbae perennes vel frutices usque ad 1 m alti. Folia petiolata, laminae ovato-ellipticae vel ellipticae, 10–62 × 4–18 mm, 2–4-plo longiores quam latiores. Spicae terminales (vel axillares), dense bracteatae; dichasia alterna, aliquando secunda, sessilia, uniflora. Bracteae petiolatae, ovato-ellipticae vel late ovatae vel subcirculares, 7–10 × 3.7–7.5 mm, pagina abaxialis pubescens trichomatibus eglandulosis. Flores sessiles. Calyx 5-lobus, 3.5–4.5 mm longus, lobis homomorphis. Corolla alba vel cremea, labio infero marronino-notata, 10–14.5 mm longa, extus pubescens trichomatibus eglandulosis. Stamina 5 mm longa, thecis 1.2–1.5 mm longis, impariter insertis vel superpositis, inferiore calcare 0.4–0.5 mm longa instructa. Capsula 4.5–7.5 mm longa, glabra.

Perennial herbs or shrubs to 1 m tall. Young stems subterete, bifariously pubescent with retrorse eglandular trichomes or ± evenly pubescent with erect to flexuose to antrorse to retrorse eglandular trichomes, the trichomes 0.3–0.7 mm long. Leaves petiolate, petioles to 20 mm long, blades ovate-elliptic to elliptic, 10–62 × 4–18 mm, 2–4 times longer than wide, acute at apex, acute to acuminate at base, surfaces pubescent with erect to flexuose to antrorse eglandular trichomes 0.1–0.4 mm long (trichomes sometimes restricted to major veins), margin entire to subsinuate. Inflorescence of ter-

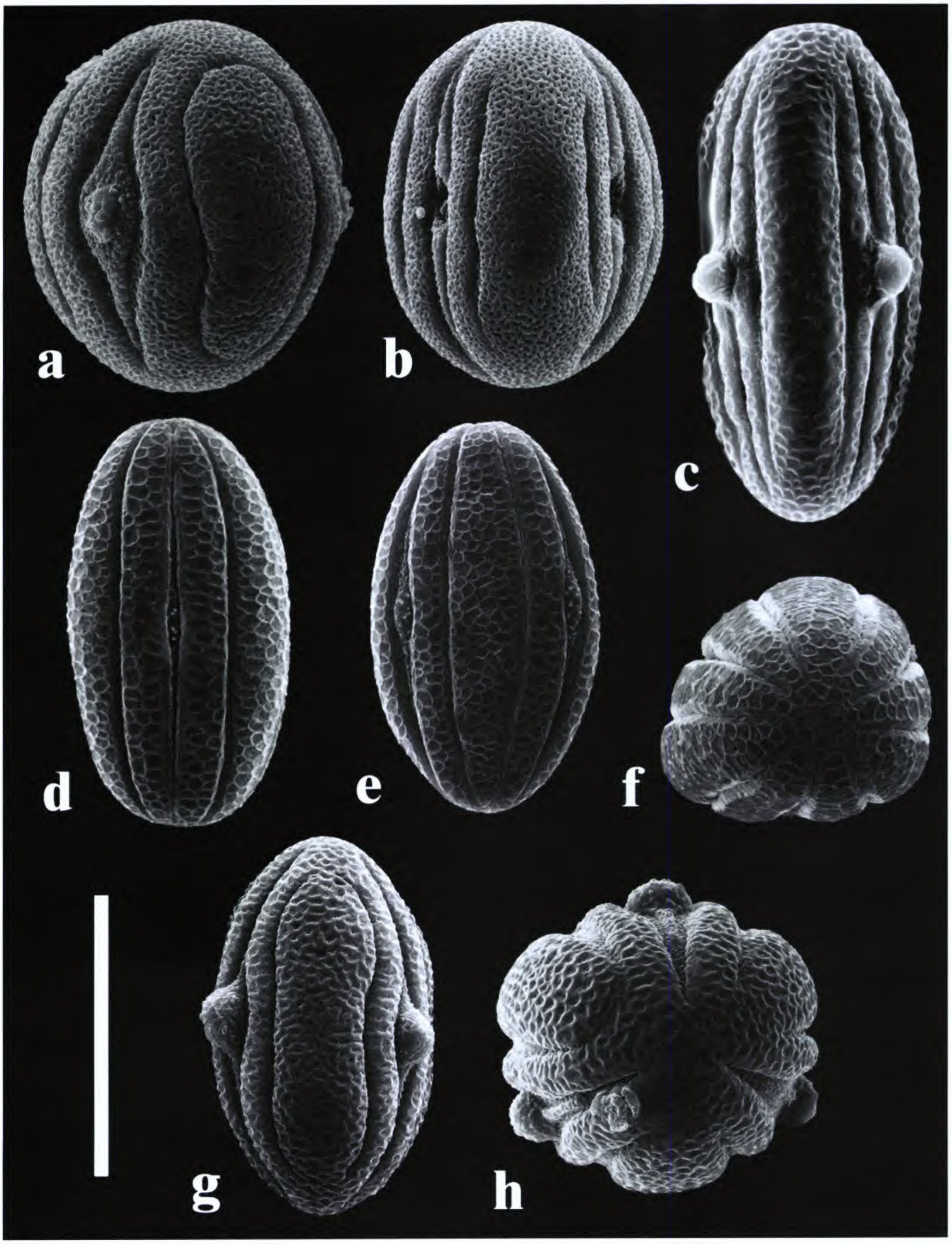

Figure 3. Pollen. —a. *Carlowrightia venturae*, subcolpal view (*Ventura & López 9336*). —b. *Carlowrightia venturae*, intercolpal view (*Ventura & López 9336*). —c. *Justicia zamudioi*, intercolpal view (*Rubio 2119*). —d. *Tetramerium carranzae*, colpal view (*Carranza & Cervantes 5470*). —e. *Tetramerium carranzae*, intercolpal view (*Carranza & Cervantes 5470*). —f. *Tetramerium carranzae*, polar view (*Carranza & Cervantes 5470*). —g. *Mirandea hyssopus*, intercolpal view (*Zamudio R. 3199*). —h. *Mirandea hyssopus*, polar view (*Zamudio R. 3199*). Scales: a–c, f, h = 27 μm; g = 30 μm; d = 35 μm; e = 42 μm.

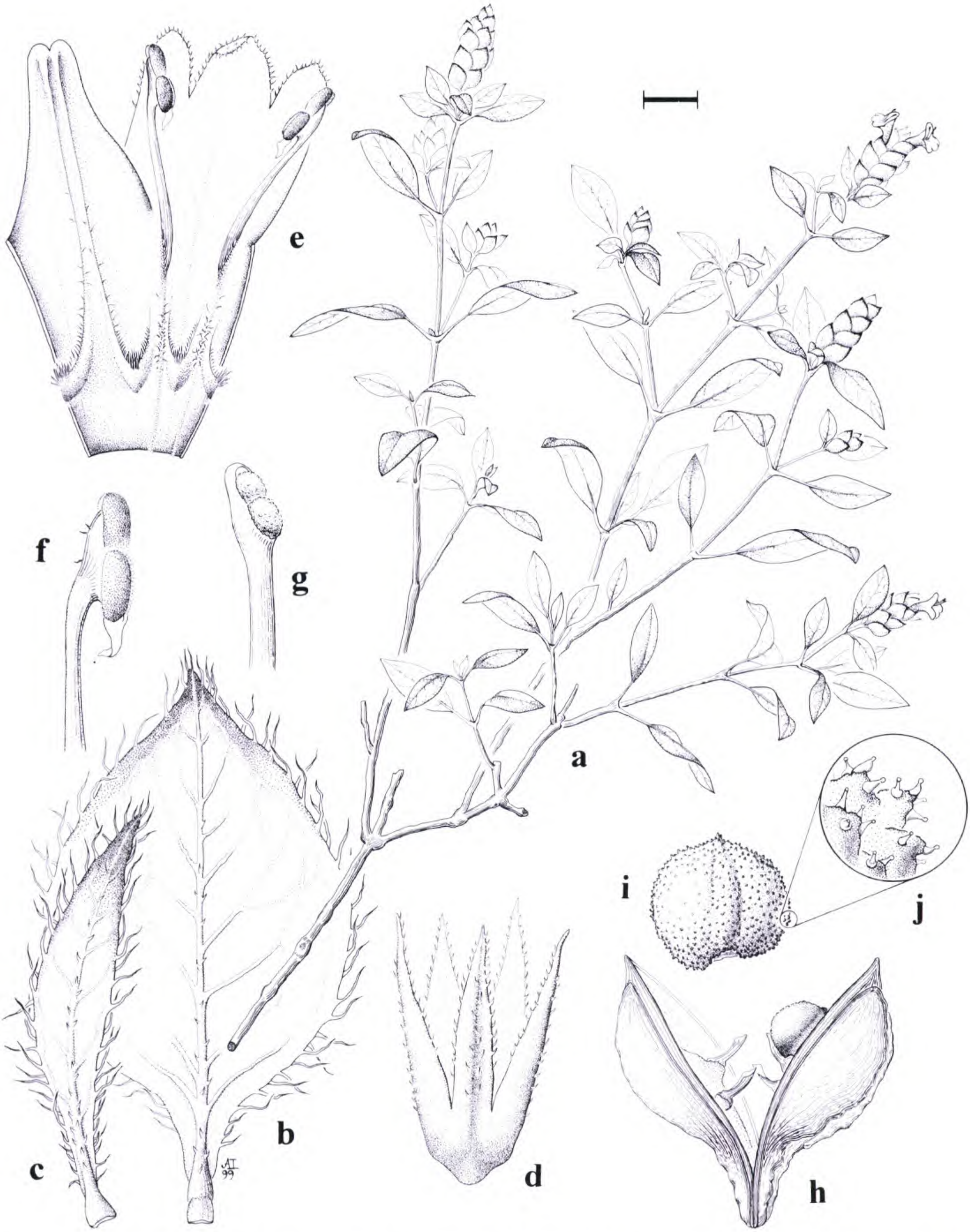

Figure 4. *Justicia zamudioi* T. F. Daniel. —a. Habit. —b. Bract. —c. Bracteole. —d. Calyx. —e. Corolla cut open with stamens. —f. Distal portion of stamen. —g. Distal portion of style with stigma. —h. Capsule. —i. Seed. —j. Seminal tubercles. a from *Carranza 2826*; b–g from *Rubio 1358*; h–j from *Rzedowski 48148*. Drawn by Anya Illes. Scales: a = 15 mm; b, c, h = 1 mm; d = 0.6 mm; e = 1.3 mm; f, i = 0.8 mm; g = 0.1 mm; j = 0.08 mm.

minal (or axillary) pedunculate densely bracteate dichasiate spikes to 46 mm long (including peduncle and excluding flowers), 10–17 mm diam. near midspike, peduncles to 8 mm long, pubescent like young stems, rachis pubescent with antrorse eglandular trichomes 0.1–0.8 mm long; dichasia alternate, sometimes borne along one side of spike, 1-flowered, 1 per axil, sessile. Bracts sometimes

yellowish green in dried plants (i.e., lighter than foliage), opposite, tinged with purple along margin near apex, borne on petioles 1.3–2 mm long, ovate-elliptic to broadly ovate to subcircular, 7–10 × 3.7–7.5 mm, apically acute, abaxial surface pubescent like rachis (trichomes sometimes sparse), margin ciliate with flexuose to antrorse eglandular trichomes to 1 mm long. Bracteoles petiolate, ovate to linear-elliptic to elliptic to oblanceolate, 6.5–9 × 1.2–2.5 mm, pubescent like bracts. Flowers sessile. Calyx 5-lobed, 3.5–4.5 mm long, lobes lance-subulate to lance-elliptic, homomorphic, 3–4 mm long, 0.6–1 mm wide, abaxially and marginally pubescent like bracts. Corolla white to cream with maroon markings on lower lip, 10–14.5 mm long, externally pubescent with erect to flexuose to retrorse eglandular trichomes 0.1–0.3 mm long, tube gradually expanded distally, 5.5–7 mm long, upper lip 4.5–7 mm long, apically 2-lobed, lobes 0.2–0.5 mm long, lower lip 4.5–7.5 mm long, lobes 2–3 × 2–3 mm. Stamens inserted near apex of corolla tube, 5 mm long, filaments pubescent with eglandular trichomes or glabrous, thecae maroon, 1.2–1.5 mm long (including basal appendage), subequal, parallel, unequally inserted (overlapping by 0.2 mm) to superposed (contiguous), dorsally pubescent (sometimes very sparsely so) with flexuose eglandular trichomes, lower theca with a basal appendage 0.4–0.5 mm long; pollen (Fig. 3) 3-aperturate, apertures flanked on each side by 1 row of insulae (these sometimes not very distinct), exine reticulate. Style 8.5–10 mm long, distally glabrous, proximally pubescent with eglandular trichomes, stigma 0.1–0.2 mm long, lobes unequal or indistinct. Capsule 4.5–7.5 mm long, glabrous, stipe 1.5–2.5 mm long, head subspheric, 3–5 mm long. Seeds 4, flat, subcircular to subcordate to subobblate, 2.1–2.3 × 2–2.3 mm, surfaces covered with subconic tubercles bearing stipelike appendages.

Phenology. Flowering: September–January; fruiting: October, January.

Distribution and habitat. Known only from Querétaro in central Mexico (Fig. 2); plants occur on slopes and along streams in thornscrub and tropical deciduous forest at elevations from 350 to 1480 m.

I am unable to associate these plants with any of Graham's (1988) infrageneric taxa or any previously described Mexican taxon. Superficially, they resemble plants from Chiapas treated by Daniel (1995) as *Justicia herpetacanthoides* Leonard. However, the Chiapan plants have opposite dichasia, sessile bracts and bracteoles, pubescent thecae, and pubescent capsules. Superficially similar plants from San Luis Potosí (e.g., *Purpus 5227*) and Tamaulipas (e.g., *F. González M. 9981*) also have pubescent thecae and capsules. Their disposition remains to be determined. The identity of *Justicia nana* (Nees) Lindau, described from Hidalgo based on a collection of Ehrenberg, also remains a mystery. The holotype of *Justicia nana* at B was destroyed, and no isotypes or other collections of the species have been located. However, based on the protologue of *J. nana*, that species differs from ours by having flowers opposite in spikes, 4-lobed calyces, and linear bracts and bracteoles.

In most specimens of *Justicia zamudioi*, the cauline trichomes are retrorse and bifariously disposed. In *Carranza 2826*, they are more or less evenly disposed and vary from erect to flexuose to antrorse to retrorse. Trichomes in the inflorescence are also denser and more conspicuous on the latter specimen.

This species is named for the collector of the type, Sergio Zamudio R., an able Mexican botanist who, through his collections and publications, has greatly contributed to our knowledge of the botanical resources in the Bajío region (Rzedowski, 1997).

Paratypes. MEXICO. **Querétaro:** Mpio. Arroyo Seco, 4–5 km SE de Ayutla, *E. Carranza 2826* (CAS, IEB); Mpio. Landa, Las Banquetas, ca. 4 km NW de Acatitlán de Zaragoza, *E. González P. 1005* (CAS, IEB); Mpio. Landa, 11 km SW de Agua Zarca, *H. Rubio 1358* (CAS, IEB); Mpio. Landa, 15 km SW de Agua Zarca, Río Moctezuma, *H. Rubio 1450* (IEB), *2119* (CAS, IEB); 19 km NE de Landa, sobre la carretera a Xilitla, *J. Rzedowski 48148* (CAS, IEB); Mpio. Landa, ca. 4 km E de La Vuelta, *S. Zamudio & E. Pérez C. 9418* (CAS, IEB).

Tetramerium carranzae T. F. Daniel, sp. nov. TYPE: Mexico. Guanajuato: Mpio. Xichú, 3 km NE de El Guamúchil, 1660 m, 22 Dec. 1997, *E. Carranza & P. Cervantes 5470* (holotype, IEB; isotype, CAS). Figure 5.

Herbae perennes vel frutices usque ad 5 dm alti. Folia petiolata, laminae ovatae vel ellipticae, 8–20 × 2.5–11 mm, 1.6–3.3-plo longiores quam latiores, pagina abaxialis pubescens trichomatibus eglandulosis (aliquot geniculatis-uncinatis) et glandulosis. Bracteae anguste ellipticae vel lineari-oblanceolatae vel obovatae, 9–15 × 1.5–10 mm, extus pubescentes trichomatibus glandulosis et eglandulosis, apice mucronatae, mucrone 0.1–0.4 mm longo. Bracteolae lineares vel lanceolatae, 4–6.2 × 0.6–1 mm. Calyx quinquelobus, 3–5 mm longus. Corolla pseudopapilionacea, caeruleo-purpurea, 20.5–26 mm longa. Capsula 7–9.5 mm longa, trichomata nulla. Semina 2.5–3 × 2.2–2.5 mm.

Perennial herbs or shrubs to 5 dm tall. Young stems subterete to subquadrate, pubescent with flexuose to antrorse to antrorsely geniculate eglandular trichomes 0.1–0.6 mm long, trichomes ± concen-

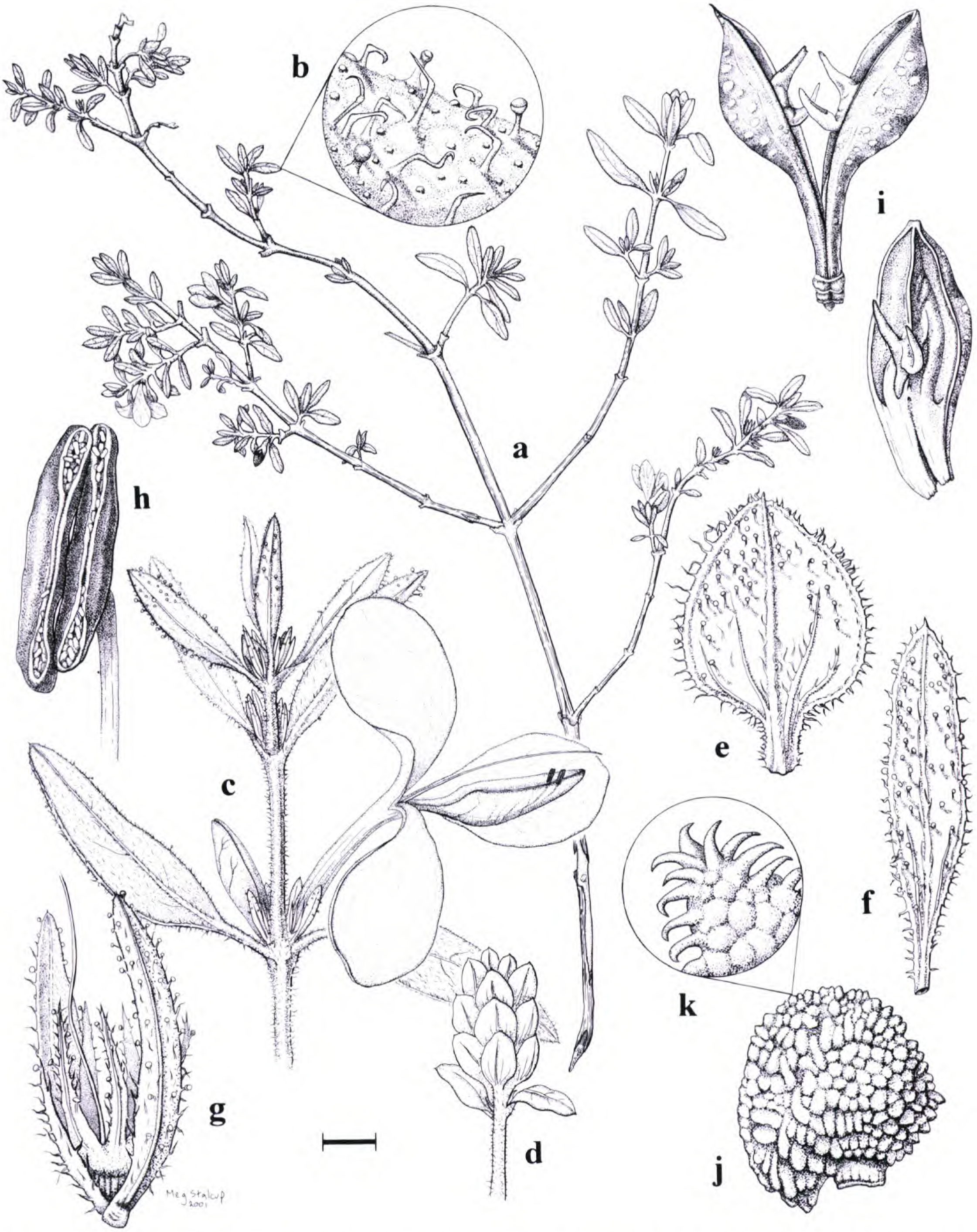

Figure 5. *Tetramerium carranzae* T. F. Daniel. —a. Habit. —b. Enlargement of abaxial surface of leaf showing trichomes. —c. Inflorescence with flower. —d. Inflorescence. —e. Bract. —f. Bract. —g. Bracteoles and calyx. —h. Distal portion of stamen. —i. Dehisced capsule (top) and single capsule valve (bottom). —j. Seed. —k. Seminal tubercle. a–c, f–h from *Carranza & Cervantes 5470*; d, e, i–k from *Carranza G. 3018*. Drawn by M. Stalcup. Scales: a = 15 mm; b, h = 0.3 mm; c = 3.8 mm; d = 10 mm; e = 2 mm; f, i = 1.5 mm; g = 3.9 mm; j = 0.7 mm; k = 0.1 mm.

trated in 2 lines or evenly disposed on youngest growth and soon becoming concentrated in 2 lines. Leaves (plants sometimes leafless or nearly so during anthesis) petiolate, petioles to 6 mm long, blades ovate to elliptic, 8–20 × 2.5–11 mm, 1.6–3.3 times longer than wide, rounded- to acute-mucronate at apex, rounded to acute to subattenuate at base, adaxial surface ± pustulate and pubescent with erect to flexuose to antrorsely geniculate eglandular trichomes and sometimes with scattered erect glandular trichomes as well, abaxial surface pubescent with antrorsely geniculate to geniculate-uncinate eglandular trichomes to 0.4 mm long and erect glandular trichomes to 0.3 mm long, margin entire, ciliate with geniculate-uncinate eglandular trichomes to 0.4 mm long, flexuose eglandular trichomes to 1 mm long, and erect glandular trichomes to 0.3 mm long. Inflorescence of terminal sessile to pedunculate loosely to densely bracteate spikes to 32 mm long (excluding peduncles and flowers), 6–23 mm diam. near midspike (excluding flowers), dichasia sometimes in axils of distalmost leaves as well, rachis visible or not, pubescent with flexuose to antrorse to antrorsely appressed eglandular trichomes 0.1–0.4 mm long and sometimes with erect glandular trichomes to 0.3 mm long as well; dichasia sessile, 1-flowered. Bracts ± petiolate, broadly ovate to broadly elliptic to subcircular to narrowly elliptic to linear-oblanceolate to obovate, 9–15 × 1.5–10 mm (proximalmost bracts sometimes subfoliose and larger), apical portion of bract usually straight and erect, rounded- to acute-mucronate, mucro straight and erect to spreading, 0.1–0.4 mm long, major veins (1 to) 3 to 5, palmate, abaxial surface pubescent with antrorse and geniculate-uncinate eglandular trichomes 0.1–0.5 mm long and erect glandular trichomes to 0.4 mm long, margin ciliate with similar trichomes and with flexuose eglandular trichomes to 1.5 mm long as well. Bracteoles lanceolate to lance-linear to linear, 4–6.2 × 0.6–1 mm, abaxial surface pubescent with antrorse eglandular trichomes 0.1–0.2 mm long or pubescent like bracts. Flowers sessile. Calyx 5-lobed, 3–5 mm long, lobes subulate, 2–3.7 mm long, abaxially pubescent like bracteoles. Corolla blue-purple and white, 20.5–26 mm long, tube 8–13 mm long, upper lip 10.5–14 mm long, 6–7 mm wide, lower lip 10–16 mm long, lateral lobes 9–15 × 5–7.5 mm, lower-central lobe 8–12 × 4.8–6 mm. Stamens 7.5–9 mm long, thecae 1.5–2 mm long. Style 16–23 mm long, stigma lobes 0.1–0.2 mm long. Capsule 7–9.5 mm long, ± pustulate but lacking trichomes. Seeds 4, 2.5–3 × 2.2–2.5 mm, surfaces minutely granulate and tuberculate with subconic to rounded protuberances bearing minute barbs.

Phenology. Flowering: December–January; fruiting: December–January.

Distribution and habitat. Central Mexico (Guanajuato, Querétaro; Fig. 2); plants occur in tropical subdeciduous forest and submontane thornscrub at elevations from 700 to 1600 m.

Pollen of *Tetramerium carranzae* (Fig. 3) is 3-colporate and 6-pseudocolpate and resembles that of other species in the genus (Daniel, 1986, 1998). Based on the infrageneric classification of *Tetramerium* proposed by Daniel (1986), *T. carranzae* can be placed in section *Tetramerium*. It would appear to be morphologically most similar to two other Mexican species with glabrous capsules, 5-lobed calyces, blue or yellow corollas, and capsules 6–9.5 mm long: *T. glandulosum* Oersted and *T. glutinosum* Lindau. These three species can be distinguished by the following key.

KEY TO *TETRAMERIUM CARRANZAE*, *T. GLANDULOSUM*, AND *T. GLUTINOSUM*

1a. Corolla yellow, lower-central lobe with marginal region along each side folded outward 90° forming a horizontal platform; mature (i.e., brownish) seeds covered with low, short, irregular ridges or rounded protuberances lacking barbs . . . . . *T. glandulosum*

1b. Corolla blue, lower-central lobe not as above (i.e., the sides remaining vertical); mature seeds covered with subconic to rounded protuberances bearing minute barbs.

2a. Young stems pubescent with glandular and eglandular trichomes; abaxial surfaces of leaves and bracts lacking geniculate-uncinate trichomes (sometimes with some eglandular trichomes antrorsely curved or bent); apical portion of bract usually twisted and reflexed, mucronate with mucro usually curved, bent, geniculate or coiled, 0.5–2.5 mm long; bracteoles 1.2–2 mm wide; thecae 2.6–3.6 mm long; seeds 1.9–2.2 mm long, 1.5–1.7 mm wide; Guerrero, México, Morelos, and Puebla . . . . . *T. glutinosum*

2b. Young stems pubescent with eglandular trichomes only; abaxial surfaces of leaves and bracts with some trichomes geniculate-uncinate; apical portion of bract usually straight and erect, mucronate with mucro straight and erect to spreading, 0.1–0.4 mm long; bracteoles 0.6–1 mm wide; thecae 1.5–2 mm long; seeds 2.5–3 mm long, 2.2–2.5 mm wide; Guanajuato and Querétaro . . . . . *T. carranzae*

The two known collections of *Tetramerium carranzae* share the diagnostic features as noted above, but differ conspicuously from one another in the shape and density of the inflorescence bracts. In *Carranza G. 3018*, the bracts are broadly ovate to broadly elliptic to subcircular, 5.5–10 mm wide, and usually have 5 major veins. They are arranged

in a dense, four-sided spike with the rachis not or only partly visible. In *Carranza & Cervantes 5470* the bracts are narrowly elliptic to elliptic to linear-oblanceolate to obovate, 1.5–3.3 mm wide, and usually have 3 major veins. They are more loosely arranged so that the rachis is clearly visible. Additionally, the rachis of *Carranza G. 3018* is eglandular whereas that of *Carranza & Cervantes 5470* is glandular. It is possible that these two collections represent different taxa, but until additional collections are available, and considering their overall similarity, they are treated as a single variable species.

Notes on the label of *Carranza G. 3018* indicate that living plants have a disagreeable odor. Several species of other acanthaceous genera with glandular trichomes also have an unpleasant (often mephitic) odor, e.g.: *Dyschoriste hirsutissima* (Nees) Kuntze, *Henrya insularis* Nees ex Bentham, and *Ruellia inundata* Kunth.

This species is named for Eleazar Carranza G., collector of both known specimens and of numerous other Acanthaceae from remote regions of northeastern Querétaro (Rzedowski, 1997).

Paratype. MEXICO. **Querétaro:** Mpio. Arroyo Seco, Río Santa María, S de El Refugio, 24 Jan. 1991, *E. Carranza G. 3018* (CAS, IEB).

Mirandea hyssopus (Nees) T. F. Daniel, comb. nov. Basionym: *Rhytiglossa hyssopus* Nees, in A. de Candolle, Prodr. 11: 345. 1847. *Justicia hyssopus* (Nees) Lindau, in Engler & Prantl, Naturl. Pflanzenfam. 4(3b): 350. 1895. TYPE: Mexico. Querétaro: "in ripâ fluvii Mosteguma prope las Ajuntas," Jan. (1840?), *C. Ehrenberg 1061* (holotype, B destroyed, photos at F, GH, MO).

Shrubs to 1.5 m tall. Young stems subterete, multistriate-sulcate, evenly pubescent with retrorse to flexuose (to antrorse) eglandular trichomes 0.05–0.4 mm long. Leaves sessile to petiolate, petioles to 2 mm long, blades narrowly ovate to lance-linear to narrowly elliptic, 9–35 × 2.4–7.5 mm, 3–7 times longer than wide, rounded to acute at apex, acute to subattenuate at base, surfaces pubescent with antrorse to flexuose eglandular trichomes 0.1–0.5 mm long, margin entire, flat. Inflorescence of terminal pedunculate dichasiate spikes to 55(–90) mm long (including peduncles and excluding flowers), 12–17 mm diam. (excluding flowers) near midspike, peduncles 2–6 mm long, pubescent like young stems, rachis not visible, evenly pubescent with flexuose to antrorse to retrorse eglandular trichomes 0.05–0.5 mm long and erect inconspicuous eglandular to subglandular to glandular trichomes to 0.05 mm long; dichasia opposite, 1-flowered, 1 per axil, sessile. Bracts opposite, homomorphic, imbricate, broadly ovate to elliptic to subcircular, 8–16 × 6–9.5 mm, often constricted into a petiole-like stalk to 1 mm long, rounded-apiculate to ± acute at apex, abaxial surface pubescent with an understory of erect glandular trichomes to 0.05 mm long and an overstory (sometimes restricted to major veins or proximal portion of bract) of antrorse to antrorsely appressed eglandular trichomes 0.1–0.5 mm long, margin ciliate with trichomes like those of abaxial surface or with the eglandular trichomes becoming flexuose. Bracteoles lance-ovate to lanceolate to elliptic, 4.5–10 × 1.4–3.5 mm, pubescent like bracts. Flowers sessile. Calyx 5-lobed, 2.5–5 mm long, lobes lanceolate to lance-subulate, subequal, 1.5–3.5 mm long, 0.7–1 mm wide, abaxially pubescent with antrorse eglandular trichomes 0.1–0.4 mm long (occasionally with a few inconspicuous glands to 0.05 mm long as well; these more prominent on adaxial surface). Corolla bluish to purplish, 12–19 mm long, externally pubescent with flexuose to retrorse eglandular trichomes 0.1–0.5 mm long, tube 6–10 mm long, ± gradually or ± abruptly expanded distally, 1.5–1.8 mm diam. near midpoint, internal surface distally pubescent with sessile to subsessile glands less than 0.05 mm long and pubescent near midpoint with erect to flexuose eglandular trichomes to 0.5 mm long, upper lip 5.3–9 mm long, entire to emarginate at apex, lobes (if present) 0.1–0.2 mm long, lower lip 5.5–9 mm long, lobes 4–5.3 × 1.4–1.7 mm. Stamens inserted near apex of corolla tube, 5.5–7 mm long, filaments pubescent with sessile to subsessile glands less than 0.05 mm long, thecae 2–2.8 mm long, equal, parallel, equally to subequally inserted, glabrous, lacking basal appendages; pollen 3-colporate, 6-pseudocolpate. Style 9.5–15 mm long, recurved near apex, pubescent with flexuose to antrorse eglandular trichomes, stigma equally 2-lobed, lobes 0.2 mm long. Capsule 10–14 mm long, pubescent with retrorse to flexuose eglandular trichomes 0.05–0.2 mm long, stipe 4–5 mm long, head subcircular, 6–8 mm long. Seeds 4 (or fewer by abortion), sublenticular, 4.3–6 × 3.8–4.7 mm, surfaces mottled, smooth, shiny, and lacking trichomes, margin entire.

Phenology. Flowering: July–November; fruiting: July–August, November.

Distribution and habitat. Central Mexico (Querétaro; Fig. 2); plants occur in thornscrub and tropical deciduous forest at elevations from 900 to 1840 m.

According to Urban (1897), on one of several trips out of Zimapán, Hidalgo Ehrenberg traveled to Ajuntas and the Río Moctezuma via Caracol in January 1840. While there is an "Adjuntas" (or "Las Adjuntas") on modern maps in northwestern Hidalgo ca. 20 km east of the Río Moctezuma and to the north of Zimapán, there is also an "Ajuntas" on the west bank of the Río Moctezuma in Querétaro. The species has been collected recently in the vicinity of this latter locale, and it is assumed to represent the type locality.

Until 1990, this species was known only from a few collections and the brief and not very diagnostic description in the protologue. With the advent of a major collecting program in Querétaro in association with the *Flora del Bajío* project, numerous collections of the species have been made recently. These make a complete description of the species possible and allow for a reassessment of its generic position.

Although *Justicia* is an exceptionally large (ca. 700 species) and morphologically diverse genus, its species possess a corolla with a rugula on the upper lip, anther thecae that usually exhibit some modifications in position and/or ornamentation, and highly derived pollen (see Daniel, 1998). While some Mexican species have unmodified thecae and/or the 3-colporate, 6-pseudocolpate pollen typical of other Justicieae (see McDade et al., 2000), all have rugulate corollas. *Mirandea* is a genus of the "*Tetramerium* Lineage" of Justicieae (see McDade et al., 2000), characterized by relatively small (up to 20 mm long), infundibular corollas with a bilabiate limb that lacks a rugulate upper lip; stamens appressed to the upper lip of the corolla with thecae opening toward the lower lip; and the style recurved just proximal to the stigma (Daniel, 1982, 1995). In these, and other characters, the species described as *J. hyssopus* conforms to *Mirandea* rather than *Justicia* and is therefore transferred to the former genus. Pollen of *M. hyssopus* (Fig. 3) resembles that of other species in the genus (Daniel, 1998).

The five species of *Mirandea*, all endemic to Mexico, can be distinguished from one another by the following key.

KEY TO SPECIES OF *MIRANDEA*

1a. Corollas yellow; leaves petiolate, petioles 8–105 mm long, blades 50–200 × 18–105 mm, rounded to cordate at base; dichasia (1- to)3- to many-flowered, borne on peduncles to 13 mm long; plants of rain forests in southern Mexico . . . . . *M. sylvatica* Acosta

1b. Corollas bluish or purplish; leaves sessile to short-petiolate, petioles 1–3 mm long, blades 3–40 × 1–7 mm, obtuse to acute to acute-attenuate at base; dichasia 1-flowered, sessile or borne on peduncles to 4.5 mm long; plants of deserts and regions of thornscrub in central and northern Mexico.

2a. Leaves linear to linear-oblanceolate, 7–20 times longer than wide; calyx 5–7 mm long; style glabrous; capsules glabrous; plants of Tamaulipas . . . . . *M. andradenia* T. F. Daniel

2b. Leaves lance-linear to lanceolate to ovate to elliptic to oblanceolate to obovate, 2–7 times longer than wide; calyx 3.5–5 mm long; style pubescent; capsules pubescent.

3a. Bracts imbricate, broadly ovate to elliptic to subcircular, 8–16 × 6–9.5 mm; bracteoles 4.5–10 mm long; filaments pubescent with sessile to subsessile glands less than 0.05 mm long; seeds 4.3–6 mm long, testa smooth; plants of Querétaro and Hidalgo . . . . . *M. hyssopus* (Nees) T. F. Daniel

3b. Bracts not imbricate, subulate to lanceolate to narrowly ovate to narrowly elliptic, 2–6 × 0.8–2 mm; bracteoles 1–3 mm long; filaments eglandular; seeds 3.5–4 mm long, testa papillose.

4a. Leaf margin flat, ciliate; dichasia pedunculate (peduncles 2–4.5 mm long), 1 per node, mostly secund; bracts narrowly ovate to narrowly elliptic, 2–4 mm long, eglandular; plants of Nuevo León . . . . . *M. huastecensis* T. F. Daniel

4b. Leaf margin revolute, eciliate; dichasia sessile, opposite at nodes, not secund; bracts lanceolate to subulate, 4.5–6 mm long, sometimes glandular; plants of San Luis Potosí and Tamaulipas . . . . . *M. grisea* Rzedowski

Additional specimens examined. MEXICO. **Querétaro:** Mpio. Cadereyta, 1 km W de Las Moras, camino a San Joaquín, *J. Rzedowski 51522* (IEB); 5 km de Las Moras a San Joaquín, *H. Díaz B. & E. Carranza 7498* (CAS, IEB); Mpio. Cadereyta, 5.5 km NW de Vizarrón, *S. Zamudio R. 3062* (IEB, MO); Mpio. San Joaquín, Cañada La Culebra, 1 km NE de La Tinaja, *S. Zamudio R. 3199* (IEB, MO, TEX); Mpio. San Joaquín, Cañada La Culebra, 1 km NE de La Tinaja, *S. Zamudio 3553* (IEB); Mpio. Peñamiller, 1 km SW de Higuerillas, *S. Zamudio 3705* (IEB); Mpio. Peñamiller, 6 km NE de Higuerillas, *S. Zamudio & H. Díaz B. 5308* (IEB); Mpio. Cadereyta, Cañada de La Culebra, NE de La Tinaja, *S. Zamudio & E. Pérez C. 10000* (IEB); Mpio. Cadereyta, ca. 1 km N de La Florida, *S. Zamudio & E. Zamudio 10263* (CAS, IEB, TEX).

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Myoxanthus ruschii (Orchidaceae), a New Species from Brazilian Atlantic Forest, Espírito Santo

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ABSTRACT. *Myoxanthus ruschii* (Orchidaceae), a new species from the Santa Lúcia Biological Station in the Atlantic forest of Espírito Santo, Brazil, is described and illustrated. This new species is related to *Myoxanthus punctatus, Myoxanthus lonchophyllus*, and *Myoxanthus seidelii*, from which it differs by non-clavate petals and the general form of the lip with a subtruncate base with a pair of reflexed lateral lobes on the end.

Key words: Atlantic forest, Brazil, Espírito Santo, *Myoxanthus*, Orchidaceae.

The eastern Brazilian Atlantic coastal forest, although at present highly fragmented, is one of the places with the highest biodiversity on Earth (Myers et al., 2000). One of these fragments with special interest is the Santa Lúcia Biological Station, a site for biological research and conservation encompassing about 440 ha of Atlantic forest located in the municipality of Santa Teresa, in the state of Espírito Santo. According to recent research on trees, birds, mammals, and butterflies there is an especially high biological richness in this region, even when compared with other Atlantic forest areas (Mendes & Padovan, 2000). As a result of fieldwork at this station, we have found a new orchid species that is described and illustrated in this paper.

The Neotropical genus *Myoxanthus* Poeppig & Endlicher, long in the synonymy of *Pleurothallis*, was reinstated by Luer (1982). Later, Luer (1992, 1997) presented a revision of the genus, consisting of 48 species in 3 subgenera, subg. *Satyria* Luer, subg. *Silenia* Luer, and subg. *Myoxanthus*, with this last subgenus containing section *Myoxanthus*, section *Antennella* Luer, and section *Scandentia* Luer. Seven species were cited for Brazil for the autonymic subgenus of *Myoxanthus*: four endemic to the eastern Atlantic forest, two in the Amazonian region, and one with disjunct distributions in eastern Brazil and northwestern South America.

Myoxanthus ruschii Fraga & L. Kollmann, sp. nov. TYPE: Brazil. Espírito Santo: Santa Teresa, Valsugana Velha, Santa Lúcia Biological Station, dry trail, ca. 19°57′10″–19°59′00″S, 40°31′3″–40°32′25″W, elev. 750 m, 16 June 2001 (fl), *C. N. Fraga 780* (holotype, MBML; isotype, RB). Figure 1.

Species haec *Myoxantho punctato, M. lonchophyllo* et *M. seideli* affinis, sed floribus parvis successivis pedunculatis aggregatis, sepalo postico oblongo, sepalis lateralibus oblongis apice obtusis, petalis elliptico-ovatis, labellis trilobatis, et lobo antico elliptico-ovato, marginibus verrucosis, et lateralibus brevibus retrorsis differt.

Epiphytic, caespitose herb. Roots coarse. Ramicauls 14–21 × 0.15–0.2 cm, ascending to erect, stout, and enclosed by 5 to 8 purple-colored, tubular hispidulous and paleaceous sheaths. Leaf 8.5–13 × 2–3 cm, erect, thickly coriaceous, narrowly elliptic to narrowly ovate, acute, base cuneate below into a subpetiole. Inflorescence a fascicle of single, successive flowers, at the apex of the ramicaul, occasionally 2 flowers at anthesis simultaneously, the peduncles purple, 7–9.5 mm long, minutely purple pubescent; floral bracts 3–5 × 2–2.5 mm wide expanded, paleaceous, purple pubescent. Flowers resupinate; pedicels 2–3 mm long; ovary 2–4 mm long; sepals yellow with red spots, glabrous, the dorsal sepal 7–8 × 2.5–3 mm, oblong, narrowly subacute, 5-veined, the lateral sepals 7–8 × 3–3.5 mm, connate at the base, oblong-ovate, apex rounded, 4(–6)-veined; petals 7–8 × 2–2.5 mm, yellow with red spots, glabrous, narrowly elliptic-ovate, obtuse, with revolute margins at the apex, 3-veined; labellum 5–6 × 2–2.5 mm, red with yellow base, non-deflexed, glabrous, the apical

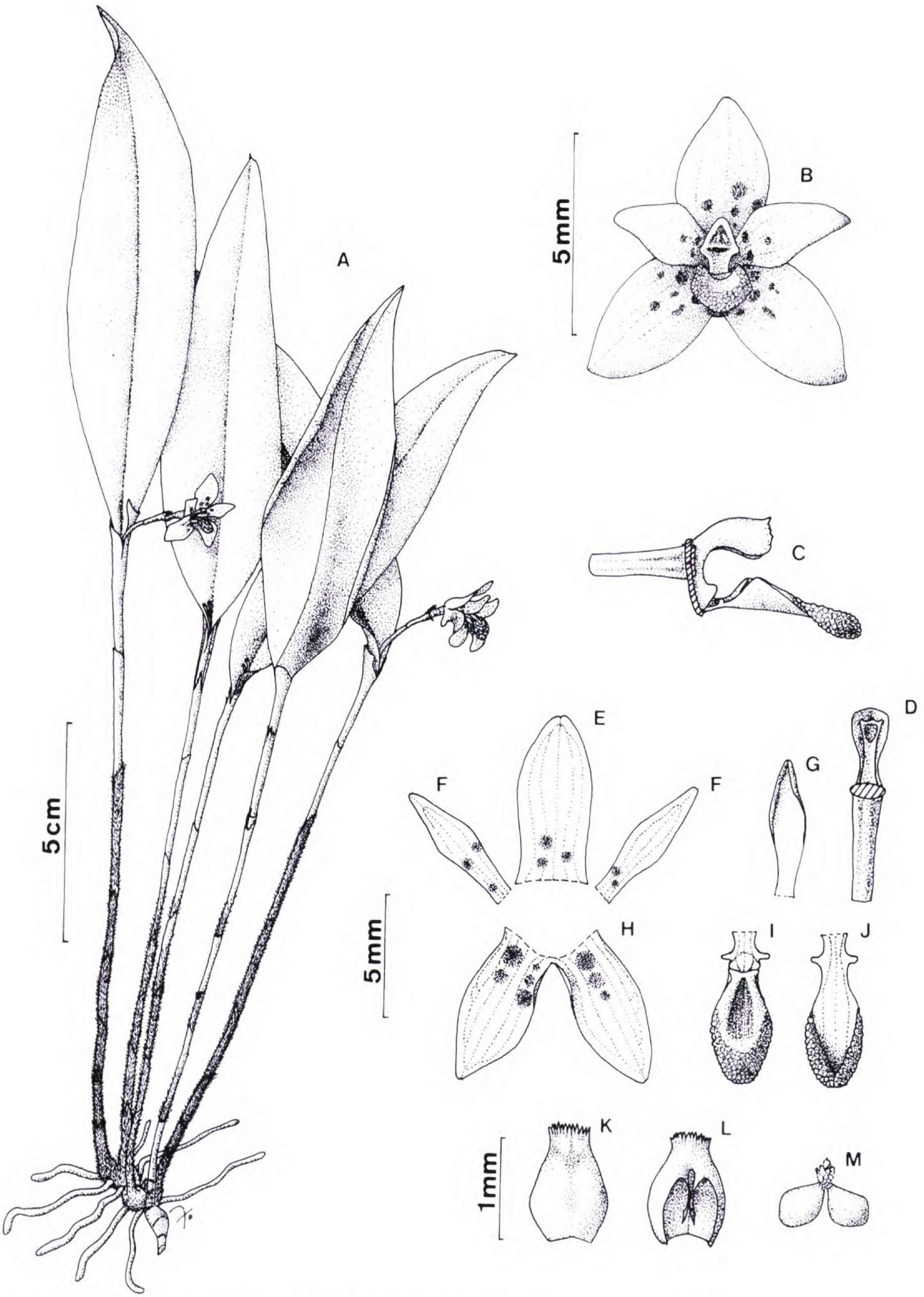

Figure 1. *Myoxanthus ruschii* Fraga & L. Kollmann. —A. Habit and inflorescence. —B. Flower. —C. Ovary, column, and lip, side view in normal position. —D. Ovary and column, from below. —E. Dorsal sepal. —F. Petal, from above. —G. Petal, from below. —H. Lateral sepal, from above. —I. Lip, from above. —J. Lip, from below. —K. Anther, from above. —L. Anther, from below. —M. Pollinia. Drawn from the type specimen (*C. N. Fraga 780*), by C. N. Fraga.

lobe elliptic, obtuse, somewhat verrucose with revolute margins, thick, the lower half with low, erect, rounded margins, the disc with a broad, smooth, slightly concave area, the base subtruncate, with a pair of minute lateral lobes reflexed on the end, 3-veined; column 1–1.5 × 0.5 mm, yellow, flecked with red, stout incurved, 3 mm long, with rounded wings above the middle, the column-foot stout, 2 mm long, concave, with a pair of thick calli near the apex, the upper margin of the anther fimbriate, 2 pollinia-pairs, yellow, obovoid. Capsule unknown.

Etymology. The name of the new species pays homage to Augusto Ruschi, a naturalist involved in the conservation of natural areas in Espírito Santo, especially through the Santa Lúcia Biological Station, which was where he started his botanical studies, particularly with Orchidaceae.

The new species is apparently related to *Myoxanthus punctatus* (Barbosa Rodrigues) Luer, *M. lonchophyllus* (Barbosa Rodrigues) Luer, and *M. seidelii* (Pabst) Luer, from which it is distinguished by its elliptic leaves, labellum thick and non-deflexed with revolute margins, and fimbriate anther.

The presence of an elliptical labellum with the terminal lobule having a verrucose margin, also observed in *Myoxanthus punctatus* and *M. seidelii*, distinguishes *M. ruschii* from *M. lonchophyllus*, which has an ovate labellum, somewhat hispid-papillose apically.

The yellow coloring with red spots, non-clavate petals, and general elliptic form of the labellum with subtruncate base with a pair of lateral lobes reflexed on the end, found in *Myoxanthus ruschii*, are characters absent in *M. punctatus* and *M. seidelii*.

Paratype. BRAZIL. **Espírito Santo:** Santa Teresa, Valsugana Velha, Santa Lúcia Biological Station, dry trail, ca. 19°57′10″–19°59′00″S, 40°31′30″–40°32′25″W, 700 m, Atlantic forest, 28 Apr. 2000 (fl), *L. J. C. Kollmann 2899, C. N. Fraga, V. G. Demuner, E. M. C. Leme & B. R. Silva* (MBML).

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New Species of Cyclanthaceae from Southern Central America and Northern South America

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ABSTRACT. Four new species of *Asplundia* and one of *Dicranopygium* are described and illustrated. *Asplundia allenii* is endemic to Panama, *D. tatica* is endemic to Costa Rica, *A. brunneistigma* is known from Costa Rica and Panama, *A. ceci* from Costa Rica to northern Colombia, and *A. albicarpa* from Costa Rica to Ecuador. *Asplundia stenophylla*, described originally from Costa Rica from sterile material and now known from Costa Rica to Ecuador, is here provided with a full description including staminate and pistillate flowers, as well as fruits.

Key words: *Asplundia*, Central America, Cyclanthaceae, *Dicranopygium*.

Over the course of the last 20+ years, collecting for the *Flora of Panama*, *Flora Mesoamericana*, and the *Manual de Plantas de Costa Rica* projects, as well as systematic collecting of large-leaved monocots by particular investigators, has given rise to the accumulation of numerous undescribed species of Cyclanthaceae from the region. Principally to make names available for the last-mentioned floristic project, the formal description of these species is here initiated.

All of the species of *Asplundia* Harling, described below, pertain to the subgenus *Asplundia*, characterized by asymmetrical and flat-topped staminate flowers, rather than symmetrical and concave as in subgenus *Choanopsis* (Harling, 1958). Although the great majority of species in subgenus *Asplundia* have leaves that are subtricostate to distinctly tricostate, three of the five species here described are unusual in having essentially unicostate leaves. Their obvious morphological similarity and certain relation to particular tricostate-leaved species is discussed. One species of *Dicranopygium* Harling subg. *Dicranopygium* is described. It is unusual (though not unique) among members of the genus for its very short and broad anthers.

Asplundia albicarpa Hammel, sp. nov. TYPE: Costa Rica. San José: Parque Nacional Braulio Carrillo, Estación Carrillo, 400 m, 28 July 1985 (fl, fr), *B. Hammel & J. Trainer 14253* (holotype, MO [2 sheets, MO-5609384 & MO-5609385]; isotypes, COL, CR, GB, INB, PMA, QCNE, US). Figure 1.

Asplundiae stenophyllae affinis sed differt laminis foliorum menoribus profunde bifidis cum segmentis latioribus menoribus profunde plicatis, floribus staminiferis majoribus cum staminibus pluribus et majoribus, floribus pistillatis cum tepalis in fructu longioribus, et stigmatibus in fructu conduplicatis.

Long-stemmed (1–2 m) climbing epiphyte and also often scandent terrestrial plant with conspicuous adventitious roots. Petiole (10–)19–52 cm long, the base dull green or often purple, the epidermis not brittle, with scant brown scales throughout, the sheath a thin, light brown and slightly fibrous soon caducous ribbon, the apex ± terete. Leaf blades 30–52(–65) cm long, bifid from just over 1/3–2/3 of their length, decurrent on the petiole, unicostate, the lower surface with very scant light brown scales; leaf segments 4–11 cm wide, lanceolate, acuminate, shallowly plicate, the veins of the plicae not adaxially elevated. Peduncle during anthesis ca. 5 cm long, up to 7(–8) cm long in later stages, the epidermis like that of the petiole base. Spathes 3 or 4, the lowest attached below the middle, the others ± evenly spaced above, the outer ones green to brown or "maroon," the inner ones white, soon fibrous and caducous. Spadix at anthesis ca. 2.5–4(–5.5) × 1.5 cm, cylindrical. Staminate flowers ca. 4 mm long, asymmetrical; receptacle ca. 2.5 mm wide, flat; perianth lobes 3 to 5, ca. 1–1.2 mm long, reaching to just above the base of the anthers; stamens ca. 40–50, the anthers 0.8–1 × 0.5 mm, from conspicuous basal bulbs ca. 0.2 mm long. Pistillate flowers ca. 4 mm wide at anthesis, to ca. 10 mm wide in young fruiting stage; tepals 1–1.5 mm long and connate (at the base) at anthesis, 5–6 mm long and connate in young fruit (in dried mature fruit to 8 mm long and connate below the middle), broadly acute to rounded truncate,

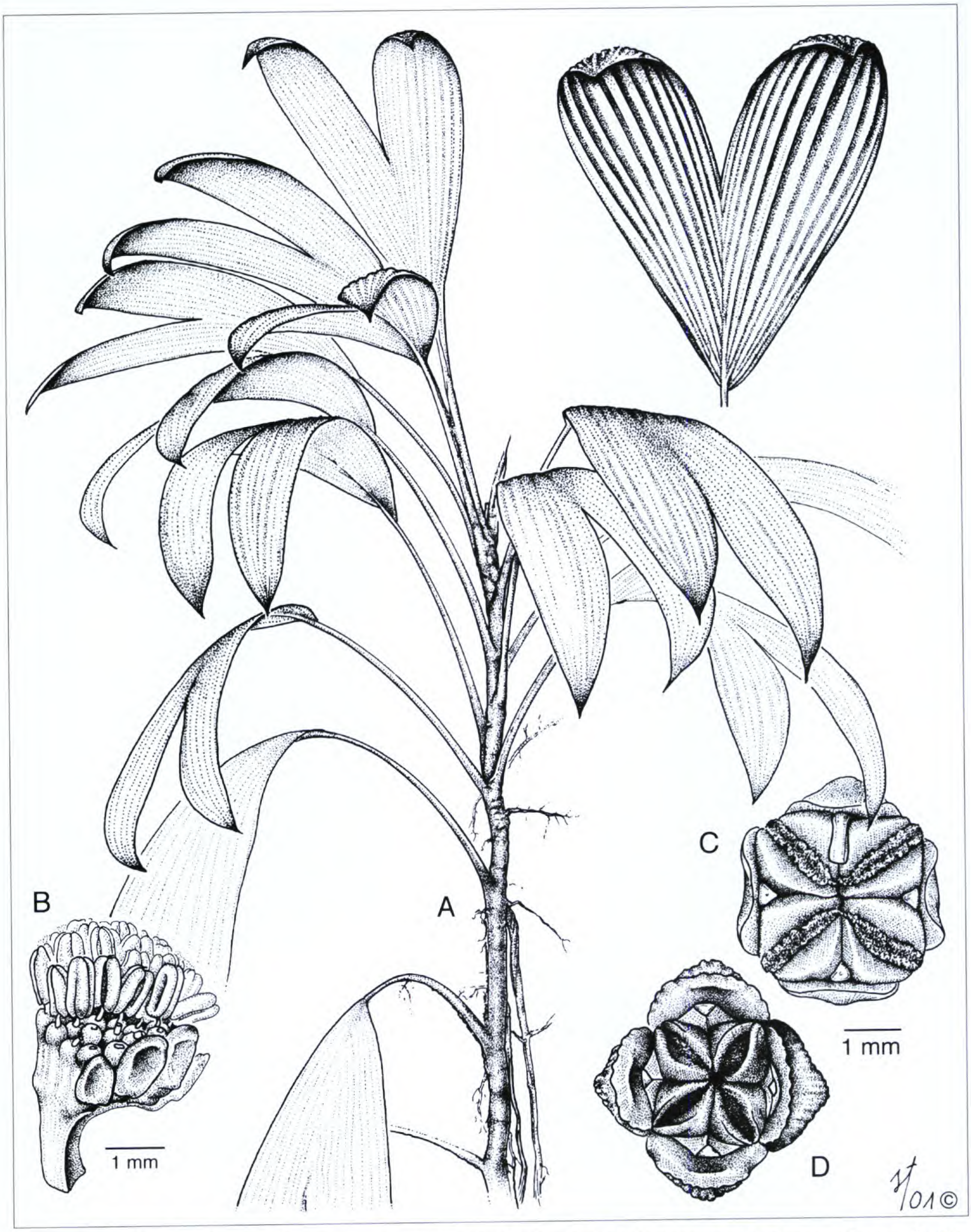


Figure 1. *Asplundia albicarpa* Hammel. —A. Habit with detail of leaf blade (upper right), lower surface. —B. Staminate flower. —C. Pistillate flower at anthesis. —D. Pistillate flower in fruit. (A–C from *Hammel & Trainer 14253*; D from *Croat & Grayum 60250.*)

equal to slightly surpassing the stigmas; styles lacking, the stigmas broadly ovoid to nearly quadrate, with the pubescent fertile part surrounded by sterile tissue that becomes conduplicately folded and turned upward in fruit, wholly surrounded by the tepals. Fruiting spadix 4–7 × 2–2.5 cm, cylindrical; fruits green-white, sometimes tinged purple, the seeds 1–1.3 × 0.6 mm wide, flattened, orange.

Distribution. Very wet primary forest of central Costa Rica to Colombia and Ecuador, 200–1800 m.

Etymology. The epithet of this new species refers to the often greenish white color of the fruiting spadix, a somewhat unusual color for species of *Asplundia*, which are more often yellow-orange or dark green.

Discussion. This new species appears to be closely related to *Asplundia stenophylla*, which has leaves that are deeply and prominently plicate throughout, as well as narrower and more deeply bifid (*A. albicarpa* leaves are usually bifid only to about the middle and deeply plicate only at the base). The staminate flowers in *A. albicarpa* are somewhat larger with usually more and larger stamens, and the pistillate flowers have tepals that become longer and stigmas with a conduplicately folded sterile part in fruit. As indicated by the epithet, the fruits of this species are often white or greenish to yellowish white at maturity, whereas those of *A. stenophylla* appear to remain green or to become greenish yellow. Mature fruits of most Central American species of *Asplundia* known to the author are bright yellow, orange, or dull red at maturity. *Asplundia albicarpa* and *A. stenophylla* sometimes occur more or less sympatrically, as for example in Parque Nacional Braulio Carrillo in Costa Rica, in Chiriquí Province of western Panama, and at La Planada Reserve in southern Colombia.

In size and shape of the leaves, *Asplundia albicarpa* somewhat resembles *A. polymera* (Handel-Mazetti) Harling subsp. *reitzii* Harling of southeastern Brazil. That species, however, has more deeply bifid leaf blades and the stamens are about half as long and half in number, in addition to the pistillate flowers having tepals reduced to low wales.

Additional specimens (fl = flower, fr = fruit, otherwise sterile). COSTA RICA. **Alajuela**: Junto al Río Sarapiquí cerca del puente, camino a Colonia La Virgen del Socorro, *Hammel et al. 17743* (CR, INB, MO). **Cartago:** 6 km N of La Suiza on the road to Pacayitas, *Solomon 19227* (INB, MO). **Heredia:** Parque Nacional Braulio Carrillo, 8 km E of San Ramón, (fr), *Loiselle 115* (MO); Estación El Ceibo, (fr), *Aguilar & Hammel 29* (CR, INB, MO), *Boyle 3108* (INB); Rara Avis, (fl), *Vargas & Frazee 48* (INB); Atlantic slope of Volcán Barba, (fr), *Grayum et al. 7776* (CR). **Limón**: N flank of Fila de Matama, (fr), *Grayum 10975, 11054* (INB); Parque Nacional Braulio Carrillo, Estación Quebrada Gonzalez a Sendero Botarama, (fr), *Hammel et al. 19090* (CR, INB, MO), *Hurtado 93* (INB), (fr), *A. Rodríguez et al. 1497* (CR, INB, MO), (fl), *M. M. Chavarría et al. 206* (CR); Teleferico del Bosque, (fr), *Hammel 19941* (INB), *Hammel 19942* (CR, INB, MO). **San José**: Parque Nacional Braulio Carrillo, Estación Carillo, (fr), *L. D. Gómez et al. 22912* (MO); sendero La Montura, (fr), *Hammel et al. 10839* (CR, INB). PANAMA. **Bocas del Toro**: Fortuna Dam area, in forest along road to Chiriquí Grande, (fl, fr), *Churchill 5532, 5866, 5878* (MO), (fr), *Croat & Grayum 60250* (MO), (fr), *Hammel & McPherson 14449, 14468* (MO), *Hammel et al. 14676, 14693* (MO), (fr), *McPherson & Aranda 10056* (MO). **Chiriquí**: along road to Fortuna dam site from Gualaca, (fr), *Antonio 5097* (MO, PMA); Quebrada los Chorros, (fr), *Churchill & Churchill 6071* (MO), (fr), *Churchill & Churchill 6072* (MO, PMA, COL), (fr), *Churchill & Churchill 6112, 6146* (MO); vicinity of Fortuna Dam, (fr), *Croat 66568* (F, MO, PMA), (fr), *Croat 67853* (GB, MO, PMA, US), (fr), *Croat & Zhu 76315* (MO, PMA), (fr), *Croat & Zhu 76343* (MO), (fr), *McPherson 7282* (MO); slope NW of confluence of Río Horninto and Río Chiriquí (fr), *Stevens 18350* (MO), (fr), *Sytsma & Stevens 2203, 2225* (MO), (fr), *van der Werff & van Hardeveld 6653* (MO), (fr), *van der Werff & van Hardeveld 6869* (MO); Cerro Colorado mine area, *Hammel & Trainer 14926* (MO). **Coclé**: above El Copé (fr), *Croat 67507* (MO, PMA); on continental divide above town, *Hammel 13648* (MO). **Darién**: Cerro Pirre, (fr), *Duke & Elias 13799* (MO); slopes of Cerro Tacarcuna, (fr), *Hammel et al. 16535* (MO). **Panamá**: vicinity of Cerro Jefe, (fr), *Croat 35912* (MO), *Hammel & Trainer 15029* (MO), (fr), *Mori 7988* (MO), (fr), *Witherspoon et al. 8284* (GB, MO); Cerro Brewster region, (fr), *Hammel & de Nevers 13549, 13554* (MO), (fr), *McPherson 7573* (MO). **San Blas (Comarca)**: Cerro Obu, (fl), *de Nevers et al. 8048* (MO), (fl), *de Nevers et al. 8072, 8085* (MO). **Veraguas**: vicinity of Escuela Alto Piedra, (fr), *Antonio 2965* (MO, F), (fl, fr), *Croat 27605, 49018, 66994* (MO), (fr), *Hamilton & Krager 3951-A* (MO), (fr), *Mori et al. 3916* (MO). COLOMBIA. **Chocó**: along road between Bolívar and Quibdó, near km marker 147, (fr), *Croat 52095* (MO); Municipio de San José del Palmar, hoyo del Río Torito, (fr), *Forero et al. 7335* (MO). **Nariño**: Reserva Natural La Planada, (fr), *Benavides 8968* (MO), (fr), *Gentry et al. 35176* (MO), (fl), *Gentry et al. 55100* (MO). ECUADOR. **Carchi**: Cerro Golondrinas, *Boyle et al. 1550, 1764* (MO). **Esmeraldas**: Reserva Etnica Awá, (fr), *Aulestia et al. 315* (MO); Mataje village, (fr), *Neill et al. 11773* (MO); Quininde, Bilsa Biological Reserve, (fr), *Pitman & Bass 794* (MO, QCNE).

Several collections, all from the Chiriquí Province of Panama, have leaves of a length and fruits of a shape more like those of *A. albicarpa*, but width of the leaf segments and depth of the division more like *A. stenophylla*. These possible hybrids between those two species are cited below:

PANAMA. **Chiriquí**: vicinity of Fortuna dam, *Croat 66580* (MO, PMA), *Croat 67823* (MO), *McPherson 7281* (MO).

Another possible hybrid with *A. albicarpa* involves, remarkably, the tricostate species *A. euryspatha* Harling. See also discussion under *A. stenophylla*. A population from near La Suiza, Turrialba, in Costa Rica seems to demonstrate a gradation in leaf and fruit morphology between *A. albicarpa* and *A. euryspatha*; an apparently intermediate specimen is cited below:

COSTA RICA. **Cartago**: de La Suiza de Turrialba rum-

bo a Pacayitas, (fr), *Hammel & Kennedy 21121* (CR, INB, MO).

Asplundia allenii Hammel, sp. nov. TYPE: Panama. Coclé: El Valle de Antón, vicinity Finca Tomás Arias, 600 m, 5 Aug. 1946 (fl & fr), *P. Allen 3623* (holotype, G; isotype, F). Figure 2.

Asplundiae sleeperae valde affinis, ob tepalis pistilatis 3-lobatis et forma stigmatum, sed differt laminis foliis formose palmatipartitis (vice simpliciter bipartitis) cum pluribus segmentis veris, non laesione fortuita, et antheris longioribus.

Terrestrial plant, acaulescent or with a short, erect stem up to 50 cm long. Petiole 112–150 cm long, the base dull green in life, drying slightly to conspicuously reddish brown. Leaf blades 61–75 cm long, split at the middle ca. 2/3 their length but overall split into 25–30 divisions that reach up to 3 cm from the base, tricostate, the lateral costae running in the margin at the base, the surface lacking scales; leaf segments 2.5–5 cm wide, linear, narrowly acute to acuminate. Peduncle during anthesis ca. 10 cm long, at least 14 cm long in later stages. Spathes 4, the lowest one attached at about the middle, the others somewhat clustered apically, fibrous and soon caducous. Spadix at anthesis 3 × 1.5 cm, ellipsoid. Staminate flowers ca. 4 mm long, asymmetrical; receptacle 3–4 mm wide, flat; perianth lobes 5 to 7, ca. 1 mm long; stamens 30–40, the anthers 1–1.4 × 0.5 mm, from rather large basal bulbs. Pistillate flowers 3–5 mm wide at anthesis, 6–8 mm wide in young fruiting stage; tepals at anthesis ca. 1 × 2 mm, free, 3-lobed nearly to base, the lobes ca. 3 mm long in fruit, acute, free and shorter than the stigmas; styles ca. 1 mm long, free at anthesis, ca. 2 mm long and connate in the lower 1/2 in young fruit, the stigmas broadly ovate, not flanked by sterile tissue, slightly projecting between the tepals, distinctly grooved in young fruit. Fruiting spadix ca. 5 × 1.5 cm, cylindrical; fruits (immature) greenish white, the seeds ca. 1.5 × 0.8 mm, flattened, orange.

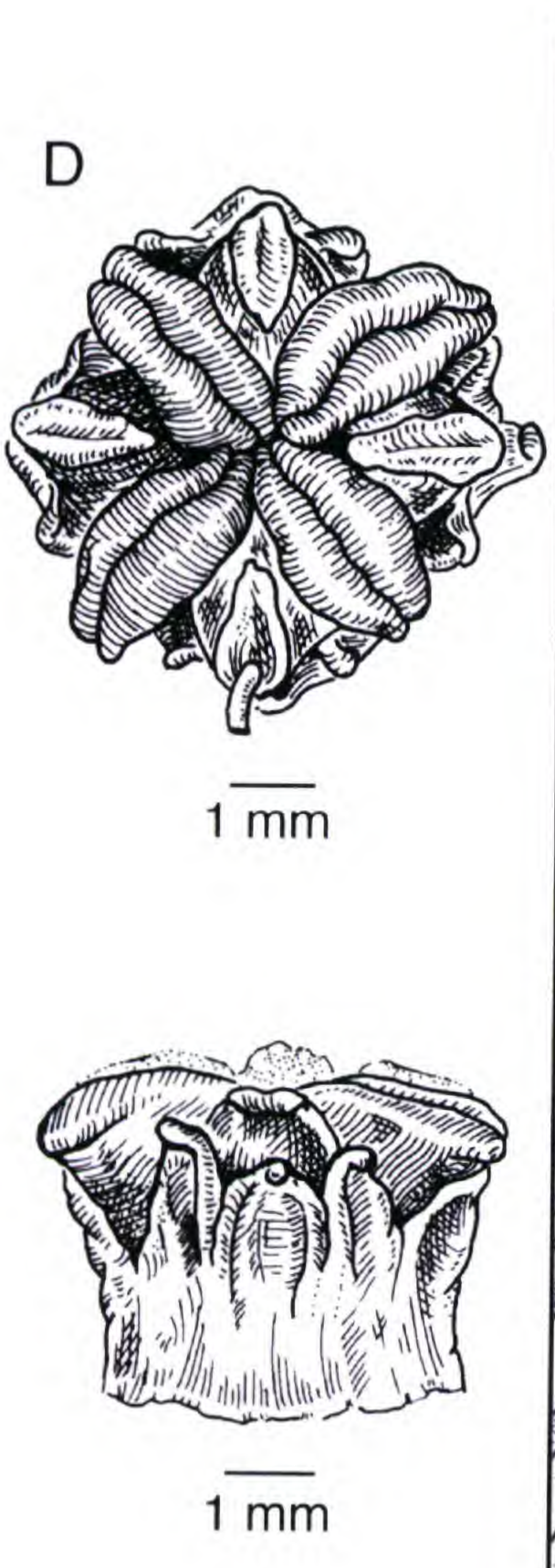
Distribution. This rare species is known from lowland forest (50–270 m) from four sites in middle to eastern Panama. It has been collected fertile only once from the region where it is most common (Río Boquerón and Río Guanche); it is found there in more or less open areas, in sandy soil along rivers and also on slopes in forest.

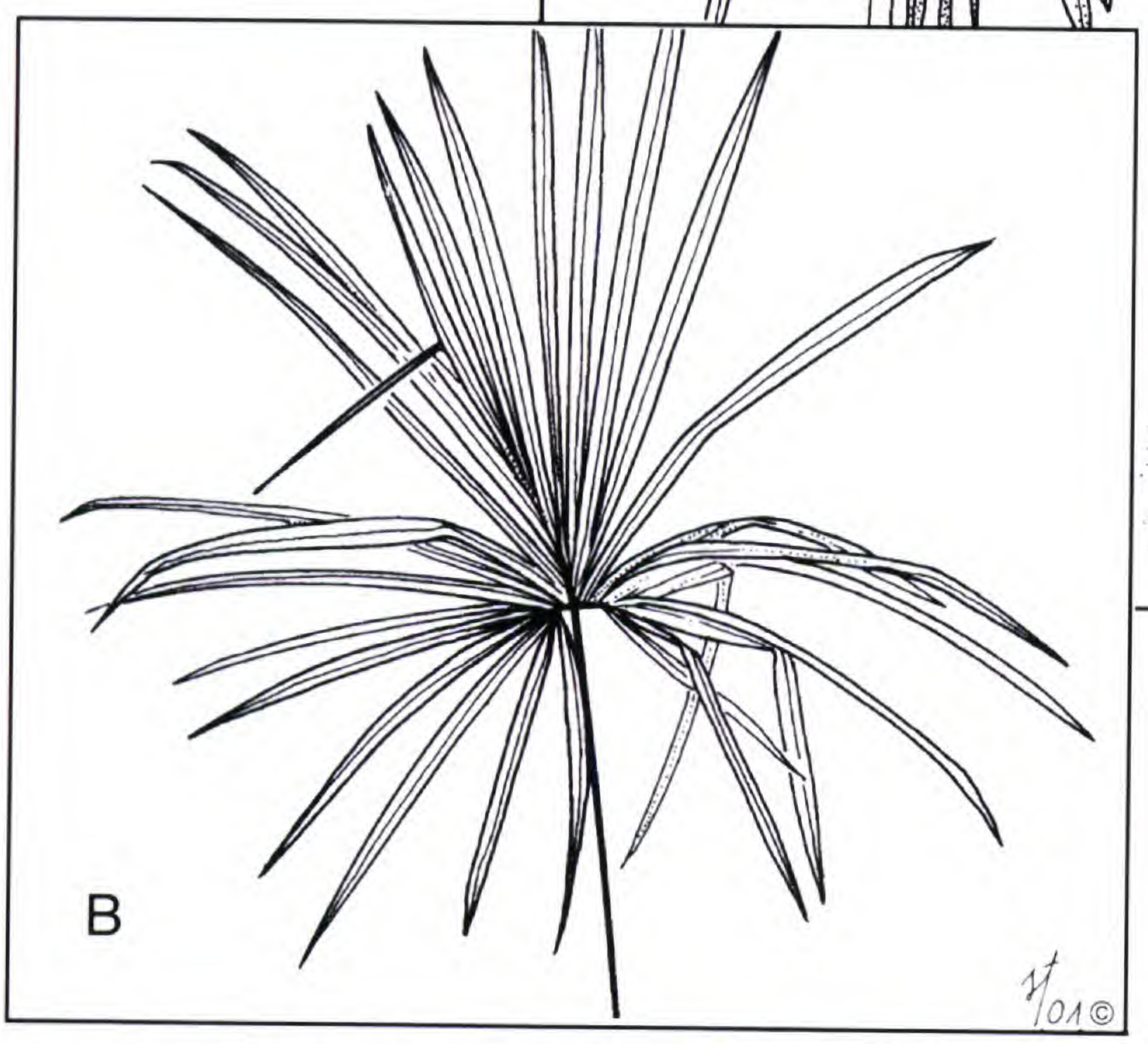
Etymology. This species is named for Paul H. Allen (1911–1963), longtime resident and botanist of the American tropics, collector of the first known specimen and, to date, the only known flowering collection of the species.

Discussion. Except for the very strikingly palmate-divided leaves with numerous, linear divisions, this species matches *Asplundia sleeperae* Grayum & Hammel quite closely, differing from it in fertile characters principally by the slightly longer anthers (0.7–1.2 mm in *A. sleeperae* vs. 1–1.4 mm in *A. allenii*). *Asplundia sleeperae* is now known from wet forests of Nicaragua to central Panama, from near sea level up to about 1200 m.

By virtue of its similarly 3-lobed pistillate tepals, as well as the shape of the stigmas, the much smaller *A. pittieri* (Woodson) Harling is also obviously related to the present new species. *Asplundia pittieri* is itself unique in the genus for having fruits that do not dehisce at maturity. In all other species known to the author, the stigmas and tepals form a unit that dehisces at the base, leaving the succulent mass of seeds on the spadix rachis. In *A. pittieri* these fruit "caps" remain fused, and the multiple "fruit" (the spadix) becomes engorged and nearly smooth at maturity, releasing the juicy, seed-laden contents more or less explosively when punctured, somewhat similar to species of *Dicranopygium*. *Asplundia pittieri* has a narrowly disjunct distribution, known in Costa Rica only from the wet forests of the southern Pacific slope (especially the Osa Peninsula) and then again in Panama from Coclé, Panamá, and San Blas Provinces. Some material from northwestern Colombia has also been tentatively identified as *A. pittieri* and *A. sleeperae*.

Numerous species of *Asplundia* have been described as having the lateral segments "secondarily split" into numerous lobes (cf. Harling, 1958, 1973), but the wording of descriptions and the dried specimens themselves have left considerable doubt as to whether or not these splits are actual lobes or merely random lacerations by physical damage to very broad-leaved species. Harling, in fact, implied that the latter is the case: "The leaf of the *schizophylla* type is, however, frayed and secondarily deeply cleft into many irregular lobes. Such lobation of old leaf blades is nothing remarkable, but a characteristic feature of many *Asplundia* species" (Harling, 1958: 235). With this new species I mean to leave no doubt: the divisions are developmental, perhaps brought about by differential growth, not lacerations from physical damage to leaves that would otherwise be only bifid. In fact, the identity of the species is dependent, in large part, upon this distinction. In southern Central America only one other species of *Asplundia* has similarly divided leaves, the epiphytic *A. aurantiaca* Harling, most certainly related to *A. dominguensis* Harling and *A. gamotepala* Harling, all quite





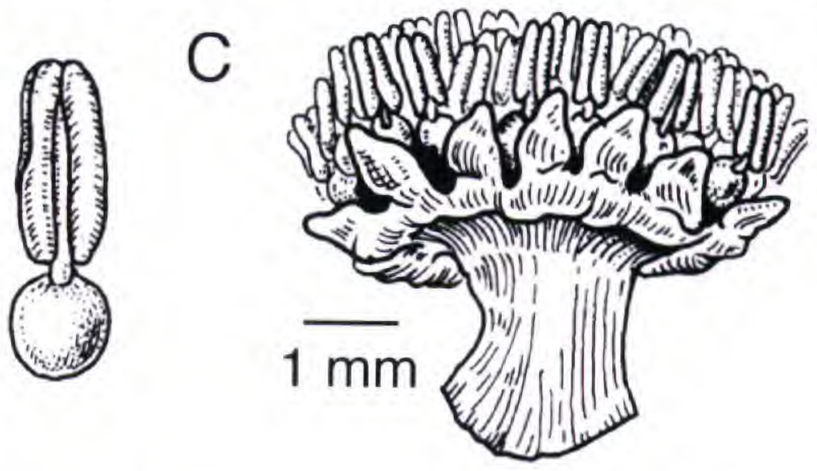


Figure 2. *Asplundia allenii* Hammel. —A. Habit. —B. Detail of leaf blade, lower surface. —C. Staminate flower with detail of stamen. —D. Pistillate flower at anthesis, top view, side view. (A, B from *Hammel & Trainer 14773*; C, D from *Allen 3623*.)

distinct from *A. allenii* (see also discussion under *A. ceci*).

Additional specimens. PANAMA. **Colón**: Río Guanche, ca. 5 km upstream from road to Portobello, *Hammel & Trainer 14773* (MO). **Darién**: Parque Nacional del Darién, Estación Rancho Frío, *Hammel et al. 16148* (MO), (fr), *Hammel et al. 16160* (MO). **Panamá**: Río Boquerón, (fr), *Dressler 4696* (GB), *Hammel & Kress 13405* (DUKE), *Hammel 16092* (MO).

Asplundia brunneistigma Hammel, sp. nov. TYPE: Costa Rica. Heredia: Parque Nacional Braulio Carrillo, primary forest between Río Pejo and Río Sardinalito, 700–800 m, 3 Apr. 1986 (fr), *M. Grayum 6709* (holotype, MO; isotypes, CR, GB, US). Figure 3.

Asplundiae peruvianae valde affinis, ob stigmatibus late rotundatis ad aliquantum quadratis, epidermide petiolorum flava et rimosa, et laminis foliorum infra cum squamis brunneis, sed ab ea et speciebus affinibus differt habitu praecipue terrestri, foliis unicostalibus et vadosis bifidis.

Terrestrial or shortly climbing caulescent plant, the stem 1–2(–3) m long. Petiole 25–40 cm long, the base with yellowish tan, shiny and brittle epidermis, elsewhere with brown scales. Leaf blades 40–75 cm long, bifid 1/3–1/2(–2/3) their length, unicostate, narrowly acute to decurrent on the petiole, the surface (especially below along veins) with conspicuous brown scales; leaf segments 6–14 cm wide, broadly lanceolate, shortly acuminate. Peduncle during anthesis ca. 10 cm long, up to 15 cm long in later stages, the base with epidermis like that of the petiole base. Spathes 3 or 4, the lowest one attached below the middle, the others ± evenly spaced above, their epidermis somewhat shiny and tan as in the petiole bases, but soon fibrous and caducous. Spadix at anthesis 3–5 × 1.5–2 cm, cylindrical. Staminate flowers 5–7 mm long, asymmetrical; receptacle 3–4 mm wide, flat; perianth lobes 5–7, 1.5–2.5 mm long; stamens 25–35?, the anthers 1.0–1.5 × 0.5 mm, from conspicuous basal bulbs ca. 0.5 mm long. Pistillate flowers ca. 7 mm wide at anthesis, to ca. 10 mm wide in young fruiting stage; tepals ca. 5 mm long and free to the base at anthesis, 6–7 mm long and free or connate to just above the middle, broadly acute to rounded, about the same height as the stigmas in young fruit; styles ca. 3 mm long and free at anthesis, ca. 7 mm long and connate to just above the middle in young fruit, the stigmas broadly ovate, wholly surrounded by the tepals, the sterile part conduplicately folded and turned upward, above the conspicuously reddish brown sulcus. Fruiting spadix 5–8 × 2.5 cm, cylindrical; fruits orange, the seeds 1–1.2 mm long, 0.5 mm wide, flattened, orange.

Distribution. *Asplundia brunneistigma* is known only from mid-elevation (400–1000 m), very wet, primary forests of central Costa Rica to central Panama.

Etymology. The epithet "brunneistigma" refers to the brown fertile tissue (contrasting with the green sterile tissue) of the stigmas as seen in live material. Although that may not be particularly distinctive among *Asplundia* species, when I was first collecting these plants it seemed so and the name has stuck.

Discussion. *Asplundia brunneistigma* is easy to distinguish by its relatively long-stemmed, usually terrestrial to sometimes climbing habit, and the narrow, shallowly divided, unicostate leaves with yellow, cracking epidermis throughout the petiole bases. Although this species might seem to resemble *A. guianensis* Harling, as per Harling's key (1958), examination of type material suggests otherwise. *Asplundia guianensis* does have a petiole with scant patches of shiny yellow and brittle epidermis, but it is otherwise quite unlike the present species (see discussion under *A. ceci*). Especially the structure of the stigmas in *A. guianensis*, being somewhat laterally flattened and without surrounding sterile tissue, is very unlike that of *A. brunneistigma*, which instead needs to be compared with *A. peruviana* Harling, *A. krukoffii* Harling, *A. venezuelensis* Harling, and *A. xiphophylla* Harling. All of these have the very same petiolar epidermis, bright yellow and cracking throughout (even in the sheath), brown scales abundant on the lower leaf surface and often also on the petiole and sheaths, as well as stigmas that are quadrate to broadly rounded, rather than laterally flattened at anthesis. From all, *A. brunneistigma* is distinct by the less deeply divided and always strictly unicostate leaf blades, as well as by its usually terrestrial (though long-stemmed) habit.

Asplundia brunneistigma is regularly infected by a gall-producing fly in the family Cecidomyiidae (Diptera). Their bright orange larvae, which affect the aerial roots, give rise to conspicuous globular galls (to ca. 1.5 cm), not seen on other Cyclanthaceae nearby. This and similar galls on the petioles of *A. euryspatha* are the only known records of galls on Cyclanthaceae (Paul Hanson, pers. comm.). Most of the fertile material known for this species is in fruit; the scant flowering material available is old, and thus it is difficult to determine the number of stamens.

Additional specimens. COSTA RICA. **Heredia**: Parque Nacional Braulio Carrillo, puesto el Ceibo, *Boyle 2883* (CR, INB, MO), *Boyle 3034* (INB, MO); between Río Pejo and Río Sardinalito, (fr), *Grayum & G. Herrera 7907* (CR,

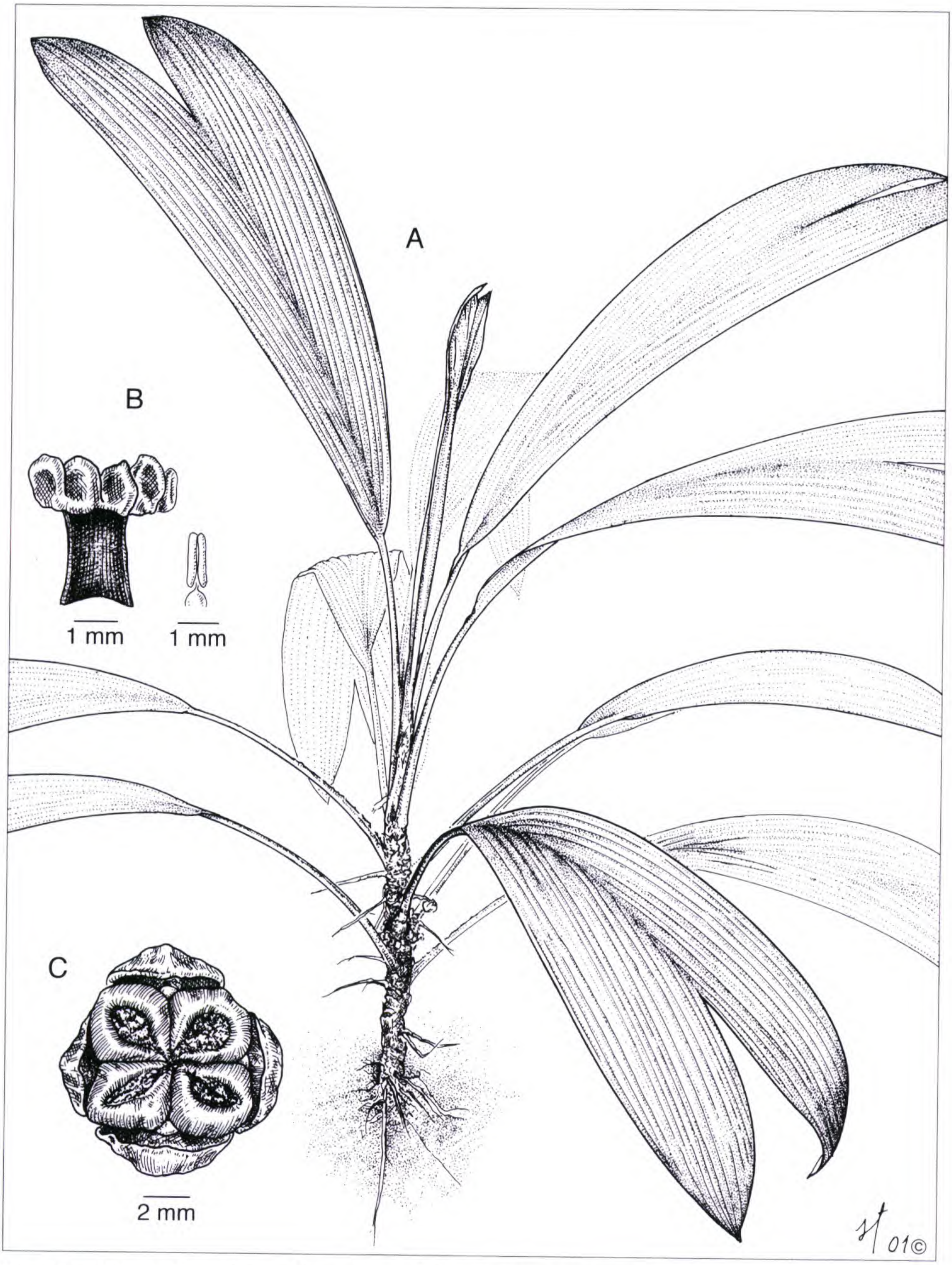


Figure 3. *Asplundia brunneistigma* Hammel. —A. Habit. —B. Staminate flower (stamens fallen) with detail of stamen. —C. Pistillate flower, young fruiting stage. (A from *Hammel 22380*; B, C from *Hammel & Kress 13639*.)

MO, F); SW of Horquetas on road to Plástico (Raras Avis), *Hammel 16710* (CR, INB). **Limón**: Quebrada Molinete, propiedad de Rainforest Aerial Tramway, (fr), *Hammel & Perry 19726* (CR, MO), (fr), *Hammel 19945* (CR, INB, MO), *Hammel 22380* (INB). PANAMA. **Coclé**: near continental divide above El Copé, (fr), *Hammel 1060* (MO), (fl, fr), *Hammel & Kress 11335, 13444, 13462* (DUKE), (fr), *Hammel & Kress 13447, 13639* (DUKE, MO). **Colón**: Santa Rita ridge, *Hammel et al. 14381* (MO). **Panamá**: Cerro Jefe, trail from end of road past Los Altos de Pacora, (fl), *Hammel & de Nevers 13572* (MO, PMA); in *Clusia* and *Colpothrinax* forest near radio tower, (fr), *Hammel & Trainer 15030* (MO).

Asplundia ceci Hammel, sp. nov. TYPE: Costa Rica. San José: Parque Nacional Braulio Carrillo, Estación Carrillo, 600 m, 28 July 1985 (fl & fr), *B. Hammel & J. Trainer 14260* (holotype, MO; isotypes, COL, CR, GB, PMA, US). Figure 4.

Asplundiae sanctae-ritae et aliis speciebus valde affinis, ob floribus pistillatis dense crebris, stigmatibus lateraliter complanatis, et squamis badiis basium petiolorum, sed ab iis differt laminis foliorum parvioribus convexis, profundioribus bipartitis, cum costis lateralibus debilibus marginalibus, et praecipue pedunculo et infructescentia brevioribus.

Profusely branching and climbing plant (liana) or rarely terrestrial, the stem to 15 m or longer. Petiole 25–40 cm long, the base dull, not cracking, reddish brown (with dense scales), elsewhere with scattered reddish brown scales. Leaf blades 25–50 cm long, bifid 3/4–4/5 of their length, subtricostate, the lateral costae in the margin, broadly acute to the base, the surface (especially below along veins) with scant reddish brown scales; leaf segments 6–10 cm wide, elliptic to oblanceolate, markedly convex above and cuspidate. Peduncle during anthesis ca. 3 cm long, 4–5(–6) cm long in fruit, also with reddish brown scales. Spathes mostly 4, ± evenly spaced above the middle, dark reddish brown, rigidly fibrous to almost woody, tardily caducous. Spadix at anthesis ca. 3–4 × 1.5 cm, ellipsoidal. Staminate flowers ca. 5 mm long, asymmetrical; receptacle 2.5–3 mm wide, flat; perianth lobes 4 to 6, 0.8–1.2 mm long; stamens 30–35, the anthers 1–1.4 mm long, from small basal bulbs ca. 0.2 mm long. Pistillate flowers ca. 4 mm wide at anthesis, 7–9 mm wide in fruit; tepals ca. 2 mm long and free to the base at anthesis, 2.5–3 mm long and connate to just above the middle, broadly rounded to truncate and sometimes emarginate, same height as or slightly lower than the stigmas in fruit; styles ca. 2 mm long and fused at anthesis, 2.5–3 mm long in fruit, the stigmas narrowly elliptic, laterally compressed, slightly projecting between the tepals at anthesis, later laterally swollen with the fertile part protruding. Fruiting spadix 4–6 × 1.5–2.5 cm, ellipsoid; fruits green, the seeds 1–1.7 mm long, 0.6–0.7 mm wide, flattened, orange.

Distribution. This somewhat rare species is known from scattered localities in very wet, mid-elevation (500–900 m) primary forests from central Costa Rica to northwestern Colombia.

Etymology. I am pleased to honor Cecilia ("Ceci") Herrera Chacón by naming this species after her. She came to us for an interview for the position of assistant to the Manual Project back in 1987, at the suggestion of her cousin, renowned Costa Rican plantsman, Gerardo Herrera. She has been with us, loyal, hard-working, and consistent, ever since. Thank you, Ceci. The epithet "ceci" is used as a noun in apposition with no Latin termination, as sanctioned by the *Saint Louis Code*, Article 23.1 (Greuter et al., 2000), and therefore not to be corrected (Art. 60.11).

Discussion. This copiously branching climber is easily recognized by its dark reddish brown stems, petiole bases, and spathes, and its small indistinctly subtricostate leaves, which, in life, are distinctly domed (convex), with the margin and tip curved down. With respect to the reddish brown stems and characters of the inflorescences (fibrous and leathery spathes) and flowers (especially the somewhat laterally compressed stigmas), among Costa Rican species it is most similar (and probably related) to *A. aurantiaca* and *A. sanctae-ritae* Galeano & Bernal. From those two, as well as from other related South American species, *Asplundia ceci* is distinct for its relatively small leaves with the lateral costae weakly developed and entirely in the margin, high climbing habit, and for the short peduncles and fruiting spadices. Overall this species looks most like *A. guianensis*, which also is said to be a rather high-climbing (to 7 m) liana. This latter species has similarly but even more weakly subtricostate leaves, traces of the reddish brown scales on various structures, and very similar pistillate flowers. The new species differs from *A. guianensis* by its somewhat smaller leaf blades with more widely divergent divisions, the shorter peduncles, and by the pistillate tepals being slightly shorter than, rather than surpassing, the stigmas in fruit. The spathe(s) of *A. guianensis* was said by the collector to be "whitish" while those of *A. ceci* are reddish brown. *Asplundia cabererae* Harling and *A. gamotepala* Harling may also share relationship by virtue of the reddish brown scales and the structure of the pistillate flowers, but both have much larger leaves, and longer peduncles (30–35 cm in the latter species). *Asplundia cabrerae* also differs from *A.*

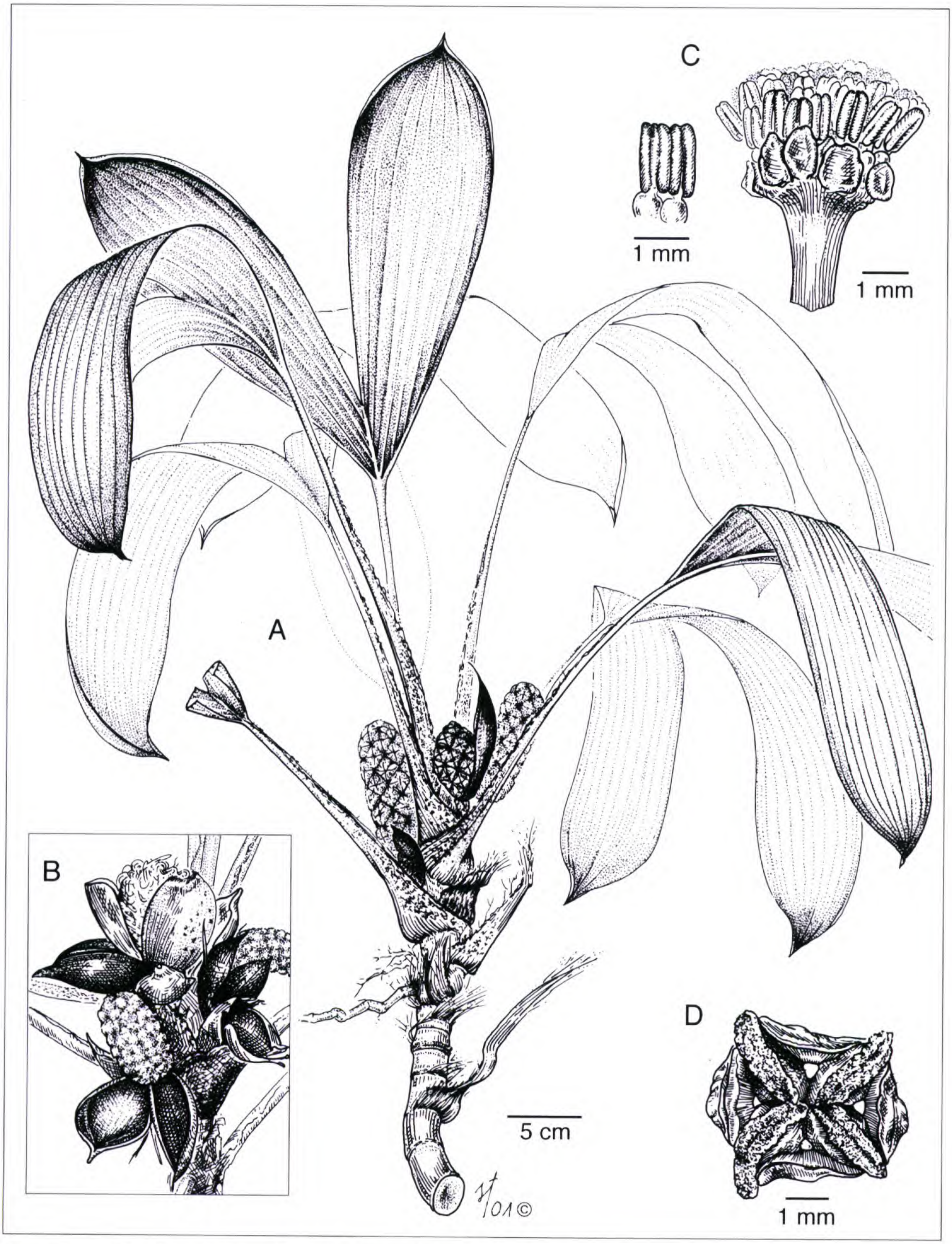


Figure 4. *Asplundia ceci* Hammel. —A. Habit. —B. Detail of inflorescences with spathes. —C. Staminate flower with detail of stamens. —D. Pistillate flower at anthesis. (All from *Hammel 22378.*)

ceci by virtue of the tepals of the pistillate flowers being free even in fruiting material. In summary, by reason of the reddish brown petiole bases and the structure of the pistillate flowers, *A. brunneistigma* is most similar to *A. cabrerae*, *A. gamotepala*, *A. guianensis*, *A. pycnantha*, and *A. sanctae-ritae*, but differs from all of them by its much smaller and more deeply divided leaves with weak lateral costae

(wholly in the margin), as well as by the much shorter peduncle and infructescence. In addition, it can be separated from *A. pycnantha* by the fused styles, from *A. cabrerae* by the fused tepals, and from *A. guianensis* by the stigmas surpassing the tepals.

Additional specimens. COSTA RICA. **Heredia**: Parque Nacional Braulio Carrillo, puesto el Ceibo, *Boyle 2908* (INB, MO); between Río Peje and Río Sardinalito, (fl, fr), *Grayum 6697* (CR, F, MO, GB, US); Horquetas to Finca Plástico, (fl, fr), *Hammel & Robles 16692* (CR). **Limón**: Quebrada Molinete, propiedad de Rainforest Aerial Tramway, (fl, fr), *Hammel 22378* (INB); Parque Nacional Braulio Carrillo, Sendero Botarrama, (fl, fr), *Hammel 19082* (CR, INB), (fr), *Hammel & Troyo 19953* (CR, INB, MO), *Lepiz 178* (INB); Río Sukút por el Río Urén, (fl), *Hammel et al. 17593* (CR, INB). **San José:** Parque Nacional Braulio Carrillo, Estación Carrillo, (fl, fr), *Hammel & Trainer 14250* (CR, F, MO, K), (fl, fr), *Hammel & Chacón 16053* (CR, MO). PANAMA. **Coclé**: El Valle de Antón, vicinity of La Mesa, (fl, fr), *Croat 67243* (MO, PMA, CAS). COLOMBIA. **Antioquia**: Municipio de San Luis, por la autopista Medellín–Bogotá, quebrada "La Mariola," (fr), *Cogollo et al. 4947* (MO, JAUM), (fl), *Hoya & Hernandez 975* (MO, JAUM).

Because fertile material of *Asplundia stenophylla* has never been described, and because one of the new species here proposed (*A. albicarpa*) appears to be closely related to it, I here provide a complete description based on the abundant fertile material now known.

Asplundia stenophylla (Standley) Harling, Acta Horti Berg. 17: 43. 1954. *Carludovica stenophylla* Standley, Publ. Field Mus. Nat. Hist. Bot. Ser. 18: 130. 1937. TYPE: Costa Rica. Cartago: El Muñeco, *Standley 33829* (holotype, US).

Long-stemmed (up to 5 m) climbing epiphyte, or rarely terrestrial plant. Petiole 20–44 cm long, the base dull green or often purple, the epidermis not brittle, sometimes with scant brown scales throughout, the apex deeply grooved. Leaf blades (44–)50–77 cm long, bifid from 5/6–9/10 of their length, decurrent on the petiole, unicostate to faintly subtricostate, the lateral costae well in from the margin; leaf segments 2.5–6 cm wide, linear, long acuminate, deeply and permanently plicate throughout, the veins of the plicae adaxially raised. Peduncle during anthesis 4–7 cm long, up to 11 cm long in later stages. Spathes 3 or 4, the lowermost at about the middle, the others ± clustered above, cream-colored, turning brown and soon caducous. Spadix at anthesis 3–4.5 × 1–1.5 cm, cylindrical. Staminate flowers 3–3.5 mm long, asymmetrical; receptacle 2.5–3 mm wide, flat; perianth lobes 3–5, 0.5–1.1 mm long, reaching to the base of the anthers or just above; stamens 30–42, the anthers 0.5–1 mm long, ca. 0.5 mm wide, from basal bulbs ca. 0.2 mm long. Pistillate flowers 4–5 mm wide at anthesis, to 11 mm wide in young fruiting stage; tepals 2–2.5 mm long and connate (at the base) at anthesis, 3.5–4 mm long and connate in young fruit (in mature fruit no longer, and connate to above the middle), acute to broadly so at anthesis, rounded truncate in later stages, equal to or slightly exceeded by (in later stages) the stigmas; styles essentially lacking (1 mm long at most), the stigmas broadly elliptic to ovoid quadrate with the pubescent fertile part flanked by sterile tissue that is only slightly raised in later stages, slightly protruding between the tepals or surrounded by (in later stages) the tepals. Fruiting spadix 5–9(–12 fide *Murphy 1172*) × 1.5–3.5 cm, cylindrical; fruits green, sometimes tinged purple or brown, the seeds 1.2–1.5 mm long, 0.6–0.7 mm wide, flattened, orange.

Distribution. This species is quite common in very wet cloud forest from 1300 to 2200 m from Costa Rica to Ecuador.

Discussion. Asplundia stenophylla, until now described from only sterile material and distinctive because of its long, narrow, very deeply divided and deeply corrugated leaves, belongs to the subgenus *Asplundia,* where it appears to be closely related to *A. albicarpa,* described herein. It appears to be further distinct from *A. albicarpa* by virtue of its petioles being deeply grooved all the way to its apex, whereas those of the latter are nearly terete at the apex. *Asplundia stenophylla* is a perplexing species because in spite of having very narrow leaf blades, they are often indistinctly subtricostate, a situation usually found only in much broader-leaved species.

Specimens examined. COSTA RICA. **Alajuela**: Monte Verde Reserve, E slope of Cerros Centinelas, (fr), *Grayum 5366* (MO); 15 km NW of San Ramón, Cerro Azahar, (fr), *Liesner et al. 15586* (MO). **Cartago**: ca. 1–2 km above El Muñeco, (fl), *Luteyn 3235* (DUKE). **Limón**: Cordillera de Talamanca, Río Siní, (fr), *Davidse & Herrera 29111* (MO); Alto Lari, (fl), *Herrera 5197* (MO). **Puntarenas**: Cordillera de Talamanca, between Cerro Frantzius and Cerro Pittier, (fr), *Davidse et al. 28410* (MO); Río Bella Vista, NW of Las Alturas, (fl), *Davidse 24342* (MO); Monte Verde Reserve, Cerros Centinelas, (fr), *Grayum & Sleeper 3850* (MO); Sendero Pantanoso, (fr), *Haber ex Bello 5203* (MO); Sendero Río, (fl), *Hammel & Trainer 13783* (MO); Sendero Nuboso, (fl, fr), *Hammel 13854* (MO); Sendero Brillante, (fl), *Hammel & Zuchowski 13888* (MO); Las Alturas, (fr), *Murphy 1172* (DUKE, MO). **San José**: about 5 km NE of San Isidro de Heredia, (fl), *John & Kathy Utley 5081* (DUKE). PANAMA. **Bocas del Toro**: Cerro Colorado mine area, (fl), *Hammel & Trainer 14902* (MO). **Chiriquí**: Cerro Horqueta, (fr), *Blum & Dwyer 2669* (MO); near Cerro Pate Macho NE of Boquete, *Hammel et al. 11395* (MO); Boquete, Palo Alto area, (fl), *Hammel et al. 14388* (MO);

Finca Ojo de Agua, (fl), *Knapp 1589* (MO); Boquete, Cerro Horqueta, (fr), *Dwyer & Hayden 7729* (MO); Distr. Bugaba, Santa Clara, Hartmann's Finca, (fl), *van der Werff & Herrera 7125* (MO). COLOMBIA. **Nariño**: Reserva Natural La Planada, (fr), *Benavides 8918* (MO), *Hammel & Bernal 15800* (MO). ECUADOR. **El Oro**: Montaña Schicay, near Cachicarán, (fr), *Steyermark 54116* (F). **Pichincha**: Canton Quito, Chiriboga, carretera vieja Quito–Sto. Domingo, (fr), *Cerón & Iguago 8515* (MO), (fr), *Hammel & Trainer 15812* (MO), Santo Domingo to Quito, Tandapi, (fr), *Hammel & Trainer 15892* (MO); Reserva Orquideológica El Pahumma, (fl), *Suin et al. 397* (MO).

At several sites in Costa Rica this species appears to grade into something with very broad, conspicuously tricostate leaves. In these areas, fertile individuals of typical *A. stenophylla* can be easily found, but also common are fertile individuals, intermediate between that and distinctly tricostate, broad-leaved individuals. On close examination, the intermediately broad-leaved individuals are slightly different (mostly in terms of the staminate flowers) from both *A. stenophylla* and what appears to be the other parent (*A. euryspatha*) in a complex hybrid zone. Collections of the narrower-leaved, but distinctly tricostate, intermediate forms are cited here below and will be labeled "*A. stenophylla* prob. X *A. euryspatha*."

Although cytology has been helpful in suspected cases of hybridity, e.g., in ferns and grasses, and one might suggest such a line of inquiry to pursue further these cases in *Asplundia*, my own attempts to get chromosome counts for Cyclanthaceae have led only to frustration. It is not for lack of trying that the family is still very poorly known cytologically (see, e.g., Eriksson, 1995). Presently, so little is known that nothing can be said even about possible chromosome evolution at the generic level, let alone comparisons be made between species suspected of hybridization.

Probable hybrids with *A. euryspatha*. COSTA RICA. **Cartago**: Tapantí, tributary of Quebrada Casa Blanca, (fr), *Grayum 3612* (MO); between Paraíso and Turrialba, (fr), *Solomon 19206* (CR, MO); Cantón de El Guarco, Carretera Interamericana, entre Cangreja y Casamata, *Hammel 19811* (INB). **Heredia**: Parque Nacional Braulio Carrillo, Puesto El Ceibo, *Boyle 1381* (CR, MO). **Puntarenas**: Monte Verde, along Río Guacimal below lecheria, (fl, fr), *Hammel & Trainer 13799* (CR, F, GB, MO, US); sendero brillante, (fr), *Hammel & Zuchowski 13889* (MO). **San José**: Cantón de Pérez Zeledón, km marker 105–116 Carretera Interamericana, (fr), *Hammel 18557* (CR, MO); km marker 117, 1750 m, (fr), *Hammel 19835* (CR, INB).

Dicranopygium tatica Hammel, sp. nov. TYPE: Costa Rica. Limón: Río Bananito, along small stream on Selva Bananito Lodge property, 300 m, 24 Mar. 2001 (fl & fr), *B. Hammel & J. F. Morales 22357* (holotype, INB; isotypes, COL, CR, MO). Figure 5.

Dicranopygio venezuelano similis, ob antheris parvis plus minusve sessilibus connectivis late triangularis insidentibus, sed differt floribus staminiferis asymmetricis cum tepalis et staminibus paucioribus, et segmentis foliorum multo angustioribus.

Short-stemmed terrestrial plant, often on rock cliffs along streams and in forest. Petiole 20–57 cm long, the base often dull purple, the sheaths falling ± entire, not as fibers. Leaf blades 35–53 cm long, bifid to about 4/5 of their length, unicostate; leaf segments 1.5–2.5 cm wide, linear, long acuminate, deeply and closely plicate with ca. 5 ridges per cm (dried material). Peduncle during anthesis 10–13 cm long, up to 22 cm long in later stages. Spathes 3, 4–6.5 cm long, long acuminate, tinged dull purple. Spadix at anthesis 1–1.5 × 0.8–1 cm, ovoid elliptic. Staminate flowers ca. 2 mm long, asymmetrical; receptacle 2 mm wide, flat; perianth lobes 5, 0.5–0.6 mm long, reaching to about the middle of the anthers; stamens 11–14, the anthers 0.5–0.8 mm long and about as wide, essentially without basal bulbs but the connective broadly triangular from about the middle down. Pistillate flowers ca. 2.5 mm wide at anthesis, 4–4.5 mm wide in young fruiting stage, the tepals ca. 1 mm long, free at the base at anthesis, ca. 2 mm long and free in young fruit, truncate, equal to the stigmas in height; styles ca. 0.5 mm long, the stigmas broadly ovate elliptic to rounded, wholly surrounded by the tepals. Mature fruiting spadix not known, but judging from the immature ones more than 2 cm long and ca. 1.5 cm wide, ovoid to cylindrical.

Distribution. So far this species is known only from the Caribbean lowlands of Costa Rica from the two nearby watersheds of Río Barbilla and Río Bananito at about 200–700 m elevation.

Etymology. Tatica is one of the many nicknames by which one of this species' early collectors, Gerardo Herrera, is fondly known among his colleagues and friends. Gerardo, who was also one of the Manual Project's early collectors, is renowned among those who know his collections, and is the stuff of legend among those who have been in the field with him. The epithet "tatica" is used as a noun in apposition.

Discussion. Dicranopygium tatica is unusual among congeners of southern Central America, not only for the long, linear leaf segments, but also for its very small anthers with basally broadened connectives. By way of the anther size, shape, and number, as well as characters of the pistillate flowers, the species seems to be related to *D. venezuelanum* Harling even though that species has symmetrical staminate flowers (with perianth lobes on

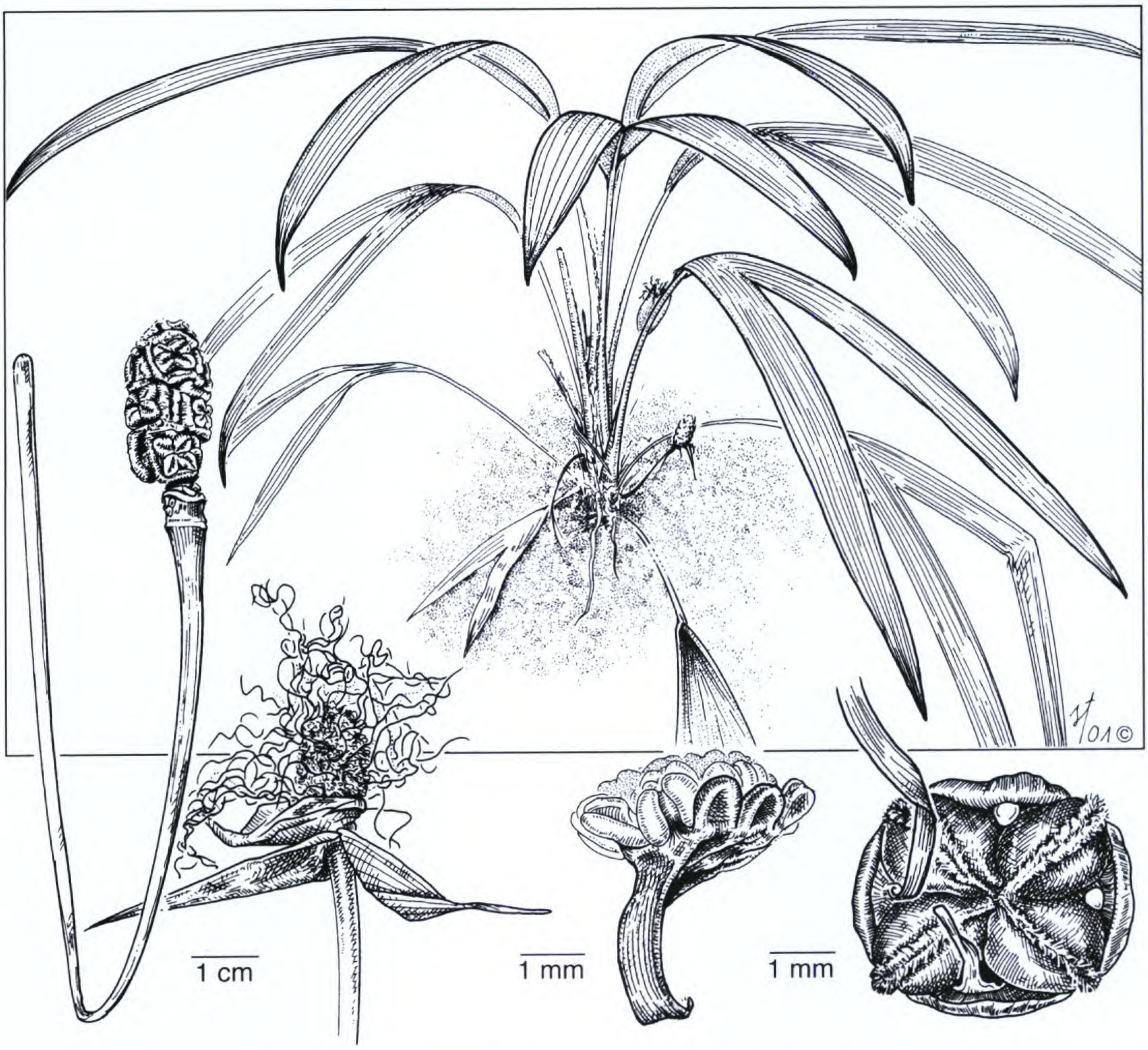


Figure 5. *Dicranopygium tatica* Hammel. Habit (in frame). Details, left to right: infructescence; inflorescence; staminate flower; pistillate flower (at anthesis). (All from *Hammel 22357.*)

all sides of the receptacle). The only other species, at least in Central America, with similar anthers is *D. harlingii,* which, however, has minute, nearly invisible staminate perianth lobes and only 5 to 8 stamens. The present new species is strikingly different vegetatively, for its long and narrow leaf segments, from all others with anthers of similar size and shape, and different also in details of the flowers.

Additional specimens. COSTA RICA. **Limón**: Cordillera de Talamanca, Río Barbilla, (fr), *Herrera et al. 2298* (CR, MO); ridge between Río Dantas and Río Barbilla, (fl bud), *Grayum et al. 8942* (MO).

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Validation of *Orobanche filicicola* (Orobanchaceae) from Korea

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ABSTRACT. *Orobanche filicicola*, invalidly named by Nakai, is nomenclaturally validated. It is related to *O. pycnostachya* and *O. amurensis* but differs markedly from them by its corolla color, style pubescence, and overall small size.

Key words: Korea, Orobanchaceae, *Orobanche*, validation.

The scientific name *Orobanche filicicola* first appeared in Nakai (1952) as a nomen nudum for an endemic Korean species; it was omitted from *The Bibliography of Eastern Asiatic Botany* (Merrill & Walker, 1938; Walker, 1960) and was not mentioned in the *Festschrift* in memory of Professor Nakai (Nakai, 1943) and his posthumous manuscripts (e.g., Nakai, 1953). Recently, W. T. Lee (1996) reported a Nakai specimen at TI that was collected at Mt. Baikyang, Changsung Gun, Korea, in 1928 and labeled as "*O. filicicola* Nakai." Except for this specimen, no other collections were found in major herbaria in Korea and Japan, including MAK, SKK, SNU, and TI. Other Korean botanists, including Chung (1957), T. B. Lee (1993), and Y. N. Lee (1997), have not considered the taxonomic identity of *O. filicicola*. Plants corresponding to *O. filicicola* Nakai were re-collected at the above locality, and its distinctiveness confirmed. Its nomenclatural validation is therefore necessary before the revision of the genus *Orobanche* L. in Korea.

Orobanche filicicola Nakai ex Hyun, Lim & Shin, sp. nov. TYPE: Korea. Chunnam: ca. 1 km N of the Office of National Parks Authority at Mt. Baikyang, along roadside, running parallel with the Hwangryong River, Changsung Gun, 4 June 1999. *J-O Hyun 1999* (holotype, SNU; isotypes, AJOU, SNU). Figure 1.

Haec species *O. pycnostachyae* et *O. amurensi* similis, sed corollis inferne albis, superne purpureis, stylo parce et breviter glanduloso piloso differt.

Parasitic perennial herb, light brown to pale yellow, dark yellow-brown when dry; plants 10–30 cm tall, 4–6 mm wide. Underground stems slightly swollen at base, 10–30 mm long, 6–10 mm wide, densely squamous; scales ovate, 10 to 20 per stem, 1–10 mm, 1–3 mm at base. Aboveground part of stems erect, densely glandular pubescent; trichomes 0.1–1 mm long. Leaves scale-like, loosely spiral, 5–7 per stem, 7–14 mm, 2–4 mm at base, chartaceous, ovate to lanceolate, apex acute, densely glandular pubescent on abaxial surfaces, trichomes 0.3–0.5 mm long, short glandular pubescent at margin, trichomes ca. 0.1 mm long. Inflorescence a terminal spike, 6–17 × 2–3 cm, densely glandular pubescent (trichomes 0.1–0.8 mm long) at rachis, flowers and bracts; spike 10- to 30-flowered, flowers subsessile or sessile; bract 1, scale-like, linear-lanceolate, apex acute, 10–16 mm long × 2–4 mm at base, usually shorter than flowers, densely glandular pubescent on abaxial surfaces (0.1–0.6 mm long) and short glandular pubescent at margin (ca. 0.2 mm long); bracteoles absent. Calyx divided into 2 lateral segments, segments free or slightly connate at base, 8–11 mm long × 2–4 mm wide at base, densely glandular pubescent at outer surface and margin (0.1–0.6 mm); segments bidentate, acute, 1.4–3.0 mm wide; teeth 4, 0.7 mm at base. Corolla bilabiate, blue violet at upper lip and white at lower lip, 1.3–2.2 cm long; tube slightly curved at 6–9 mm from base, corolla tube straight in the upper part, 2.5–3.5 mm wide at lower part, 3.2–5.0 mm wide at upper part, densely glandular pubescent on outer surface (trichomes ca. 0.1 mm), villous at the base of inner surface (trichomes 0.2–0.7 mm); upper lip emarginate, ca. 2.5 × 3–5 mm; lower lip 3-lobed, all lobes orbiculate to subrounded, ca. 3.6 × 2.5 mm, margin sinuate to irregularly dentate; upper and lower lobes densely glandular pubescent (ca. 0.1 mm) when young, sparsely so when old. Stamens 4, didynamous, included, 10–12 mm long; filaments inserted 4–6 mm from the base of corolla, sparsely glandular pubescent (ca. 0.1 mm), white villous at the base (ca. 0.5 mm); anthers ovoid to ellipsoid, ca. 1.8 × 0.9 mm, 2-locular, villous (ca. 0.9 mm). Ovary 1-locular, placentas 4, parietal, 5.8–7.5 mm long, ca. 2.1 mm wide; ovules numerous; styles elongate, ca. 12 × 0.4 mm, dilated, glandular pubescent ca. 3.5 mm from base; trichomes ca. 0.2 mm long; stigma 2-lobed, ca. 1.5 mm wide. Capsule and seeds not seen.

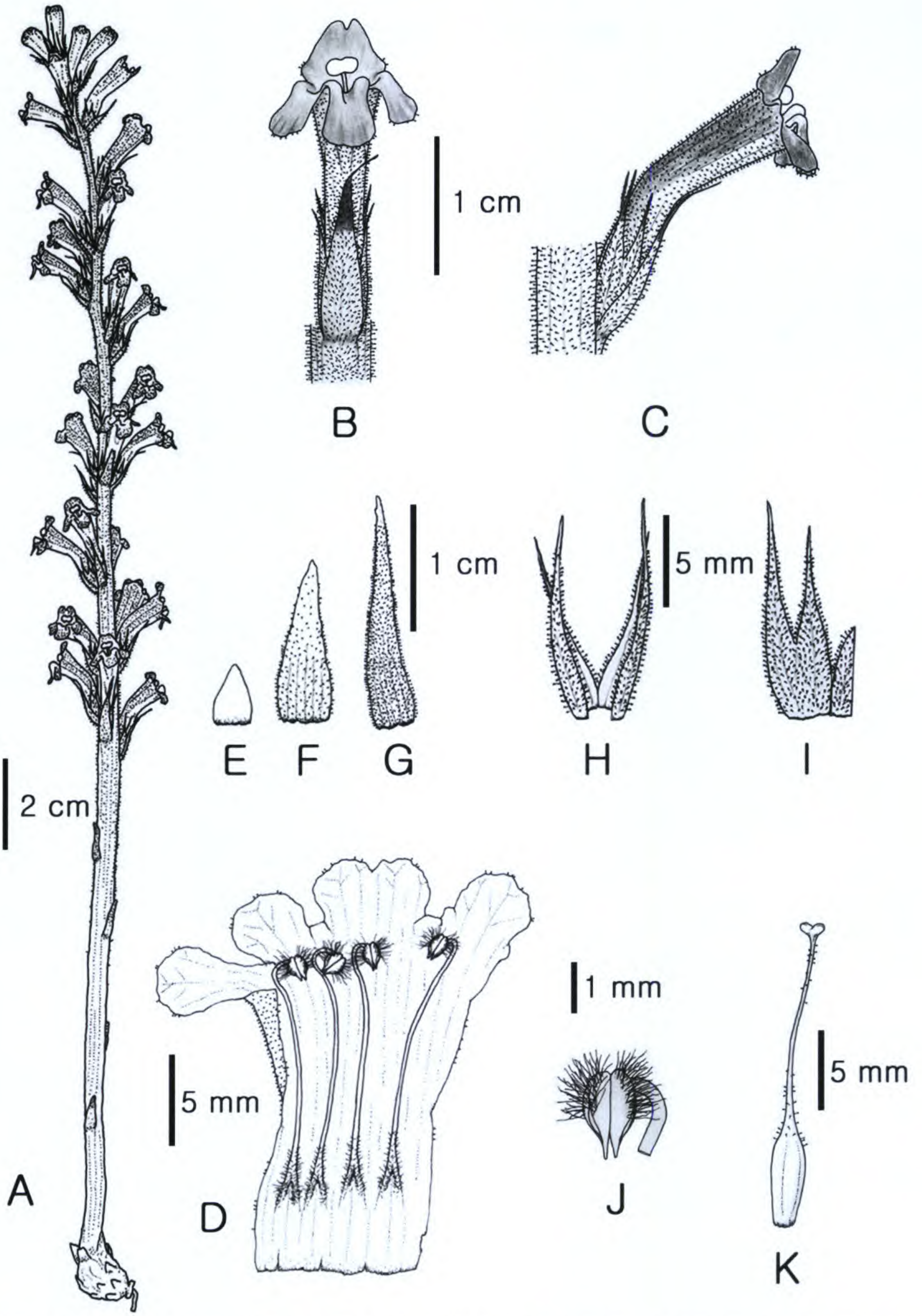

Figure 1. *Orobanche filicicola* Hyun et al. —A. Habit. —B. Flower, frontal view. —C. Flower, side view. —D. Opened flower showing the stamens. —E. Rhizome scale. —F. Leaf-like scale from aerial stem. —G. Bract. —H. Calyx, internal view. —I. Calyx, external view. —J. Anther. —K. Pistil. Drawn from *J-O Hyun 1999* (holotype, SNU).

Table 1. Morphological comparison of *Orobanche filicicola*, *O. pycnostachya*, and *O. amurensis*.

Characters	*O. filicicola*[1]	*O. pycnostachya*[2]	*O. amurensis*[3]
Plant height (cm)	13–30	10–45	10–45
Flowers in inflorescence	lax, sometimes dense	dense	lax, less commonly dense
Inflorescence length	longer than the rest of the stem	shorter than the rest of the stem	somewhat shorter than the rest of the stem
Bract length (mm)	10–16	12–22	15–20
Bract shape	linear-lanceolate	ovate to broadly lanceolate	broadly lanceolate
Bract apex	acute	acuminate	acute
Calyx length (mm)	8–11	10–15	8–18
Corolla length (mm)	13–22	15–30	18–25
Corolla color	blue-violet	yellow	dark purple
Style pubescence	sparsely glandular	sparsely glandular	subglabrous

[1] Based on the type specimen.
[2] Based on the description of Komarov (1907), Novopokrovskij and Tzvelev (1958), Zhang and Tzvelev (1998), and specimens deposited at MAK and TI.
[3] Based on the description of Komarov (1907), Novopokrovskij and Tzvelev (1958), and specimens deposited at TI.

Etymology. The species epithet "filicicola" consists of two Latin words, *filici-* (= relating to ferns) and *-cola* (= confined to), and was made by Nakai, who had annotated his specimen label in Japanese as "parasitize on inuwarabi," the Japanese name of *Athyrium niponicum* (Mettenius) Hance (Aspleniaceae).

Habitat and host. Fifteen plants inhabited a gravelly place between the river and the forest margin along a roadside. Plants of *Artemisia* species surrounded this species, and *Miscanthus* species occurred nearby. However, no plants of *Athyrium niponicum* were found. Concerning the host plants of Orobanchaceae, Theiret (1971) stated emphatically, "Reports of Orobanchaceae on ferns require verification." Therefore, the host plant may be *Artemisia* species rather than *Athyrium niponicum.*

This species was named by Nakai (1952). The name was effectively, but invalidly published (nom. inval., nom. nud.) because of the lack of a diagnosis and type. Following the taxonomic arrangement of *Orobanche* L. proposed by Beck-Mannagetta ([1930] 1991), *O. filicicola* belongs to section *Osproleon* Wallroth, subsection *Inflatae* Beck, which consists of six species. Among them, *Orobanche filicicola* is characterized by glandular stems and flowers, densely villous anthers along the sutures, blue violet corolla with white lower part, and deeply 2-parted calyx.

Orobanche pycnostachya Hance and *O. amurensis* (G. Beck) Komarov (= *O. pycnostachya* var. *amurensis* G. Beck) resemble *O. filicicola* in having glandular trichomes on the stems and flowers, and the deeply 2-parted calyx, characteristics of subsection *Inflatae* (Beck-Mannagetta, [1930] 1991) including Chinese and Russian species (Novopokrovskij & Tzvelev, 1958; Zhang & Tzvelev, 1998). *Orobanche pycnostachya* differs by having a yellow corolla and a more broad and acuminate floral bract; *O. amurensis* differs in its subglabrous style base and abruptly narrowed floral bract (Table 1). In addition, the plants of *O. filicicola* are smaller in size compared to both species (Table 1), including plant height, and bract, calyx, and corolla length.

Paratype. KOREA. **Chunnam:** Mt. Baikyang, Changsung Gun, 4 June 1928, *T. Nakai 12147* (TI).

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A Second Species of *Smithatris* (Zingiberaceae) from Myanmar

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ABSTRACT. *Smithatris myanmarensis*, the second species of a previously monospecific genus, is described from Myanmar. This new species differs from its congener in Thailand by the overall smaller stature, elliptic leaf lamina with long petioles, dimorphic inflorescence bracts, corolla lobes of similar size and shape, the pouch formed by the labellum and lateral staminodes below the anther, and the shallowly lobed labellum.

Key words: Myanmar, *Smithatris*, Southeast Asia, Thailand, Zingiberaceae.

Members of the Zingiberaceae are commonly used as medicinals, spices, foods, and ornamentals in local and regional cultures throughout Southeast Asia. Our understanding of their diversity and taxonomy has entered a new phase during the last decade with the description of many new taxa, including new genera (e.g., Newman, 1995; Mood & Larsen, 1997; Larsen & Mood, 1998; Sakai & Nagamasu, 2000). The recently described genus *Smithatris* (Kress & Larsen, 2001) with a single species, *S. supraneeana* W. J. Kress & K. Larsen (as "*S. supraneanae*"), is commonly used in local ceremonies during the Buddhist Lent and has now become widespread in commercial nurseries. Although then known only from natural populations in Thailand, the authors predicted that *Smithatris* might also occur in adjacent Myanmar. Here we describe a second species of this genus from the western slopes of the Shan Hills in Myanmar.

Smithatris myanmarensis W. J. Kress, sp. nov. TYPE: Myanmar. Mandalay Division: Thabeikyin Township, Shwe-U-Daung National Park, elev. 500 m, 22°59′37″N, 96°08′32″E, 11 June 2001, *W. J. Kress, Thet Htun, M. Bordelon, K. Williams & T. Rehse 01–6890* (holotype, US; isotypes, AAU, E, MO, RAF). Figure 1.

Smithatre supraneeana foliis petiolatis, bracteis inflorescentiae congestis, tubis corollarum longis post anthesin spiraliter crispatis proxima, sed statura minore, laminis foliorum ellipticis petiolis longis munitis, bracteis inflorescentiae dimorphis, lobis corollae amplitudine formaque inter se similibus, labello minime lobato, staminodiis lateralibus saccum sub anthere formantibus differt.

Medium-sized rhizomatous herb, roots without spherical tubers. Stem up to 100 cm in height. Leaves 3 or 4 per shoot; sheaths dark green, ligule minute and papery; petiole green, punctate, varying in length from 5 cm in basal leaves to 20 cm in upper leaves, ca. 7 mm diam.; lamina elliptic, glabrous, punctate below, deep green, median nerve deep green, slightly sunk on the upper surface, more prominent below, apex acute, base attenuate, up to 45 × 14 cm; lower leaves reduced in size. Inflorescence terminal on leafy shoot; peduncle green, up to ca. 35 cm in height, terete, 6–8 mm diam.; inflorescence bracts numerous, 20 to 25 per inflorescence, congested, overlapping, spirally arranged, dimorphic, lower bracts bright green, each bract subtending 1 or 2 flowers, ca. 3.5 cm long, 2.5 cm wide, apex curved outward and joined at the base forming an open pouch, acute distally, upper sterile bracts white, sometimes pink, 5–6.5 × 1.5–2.5 cm, suberect, only slightly joined at base, acuminate distally. Bracteoles small, 5–6 mm in length, white, glabrous. Flowers with calyx tubular, white, glabrous, 6–7 mm in length, 3-dentate; corolla tube white, hidden by bracts, sparsely puberulous, narrow, 1.5 mm diam., ca. 2.2 cm long slightly widening below the lobes, lobes yellow, ca. 5 × 2.5 mm, ovate, all lobes similar in shape and size; after anthesis the corolla tube curling in a spiral fashion retracting the flower into the bract before deteriorating; lateral staminodes yellow, sparsely puberulous, slightly shorter than the corolla lobes, acute, adnate to the labellum forming a loose pouch below the anther; labellum yellow, sparsely puberulous, shallowly lobed with margins

Figure 1. *Smithatris myanmarensis* W. J. Kress. —A. Habit with terminal, pedunculate inflorescence. —B. Inflorescence with bracts cut away showing orientation of flowers and bracteoles. —C. Bracteole. —D. Calyx tube. —E. Apex of flower showing relationship of corolla lobes, staminodes, anther, and stigma, lateral view. —F. Apex of flower showing relationship of corolla lobes, staminodes, anther, and stigma, front view. —G. Longitudinal section of entire flower. —H. Longitudinal section of base of perianth and ovary showing two epigynous nectary glands. —I. Cross section of corolla tube showing groove with inserted style. —J. Cross section of ovary. —K. Post-anthesis corolla tube becoming spirally curled and retracting flower into the bract. Drawn from *W. J. Kress 00–6749* (US).

slightly involute at anthesis; stamen yellow, ca. 3 mm in length, anther not versatile, pollen sacs without prolongations at base, connective extending beyond the pollen sacs and stigma to form a rounded crest; stigma white, funnel-shaped; epigynous nectary glands 2 at base of corolla tube, ca. 2.5 mm in length with acuminate apex; ovary cream, ca. 1.5 mm long; pedicel obscure. Fruit and seeds unknown.

Distribution and habitat. This species has only been recorded from a few localities in Myanmar in Mandalay Division on the western slopes of the Shan Hills. *Smithatris myanmarensis* is found in the understory of wet evergreen and bamboo forests, often associated with limestone formations.

This second species of *Smithatris* is similar to *S. supraneeana* in the petiolate leaves, long pedunculate inflorescences with congested bracts, and long corolla tubes that curl in a spiral fashion retracting the flower into the bract after anthesis. However, *S. myanmarensis* differs from the earlier described species in its overall smaller stature (ca. 1 m), elliptic (vs. lanceolate) leaf lamina with longer petioles (up to 20 cm vs. 4 cm), shorter inflorescence peduncles (less than 35 cm vs. 100 cm), and dimorphic inflorescence bracts. In this species the basal bracts are green and subtend one or two flowers while the apical bracts are conspicuously colored (white or pink) and contain no flowers. In *S. supraneeana* all bracts are brightly colored and fertile. The flowers of the two species also differ considerably. In *S. myanmarensis* the three corolla lobes are similar in size and shape, whereas the dorsal lobe is hooded and larger than the lateral lobes in *S. supraneeana*. The labellum and the lateral staminodes in *S. myanmarensis* form a loose pouch below the anther, whereas in *S. supraneeana* the lateral staminodes with the dorsal corolla lobe form a hood above the anther. One of the most conspicuous differences is the deeply divided labellum in *S. supraneeana* as contrasted to the shallowly lobed labellum in the new taxon. Together the above features clearly distinguish *S. myanmarensis* from *S. supraneeana*.

Morphologically this new species shares more characters with *Smithatris supraneeana* than with any other taxon in the Zingiberaceae. However, the differences between these two species as discussed above suggest some caution as to its generic placement. Furthermore, recent investigations on the phylogenetic relationships among genera of the family utilizing DNA sequence data (Kress et al., 2002) indicate that generic boundaries are not well supported in the clade containing *Smithatris*, *Curcuma*, *Stahlianthus*, and *Hitchenia*. For these reasons, we tentatively place the new species in *Smithatris*, but caution that future studies using molecular and morphological characters may establish new generic alignments.

The earlier described taxon, *Smithatris supraneeana*, is well known by local inhabitants in Thailand. This species is sold as a cut flower in markets near the renowned temple of "Phra Putthabat" (the "Footprint of Buddha") where it is used in ceremonies during the Buddhist Lent (Kress & Larsen, 2001). Although we have not seen *S. myanmarensis* sold in markets in Myanmar, we have observed its use as an offering in household Buddhist shrines. This species has great potential for local and regional horticultural use as an ornamental similar to "Globba magnifica K. J. Williams & M. Newman," ined. ("Padein-ngo"), which is sold in markets and distributed throughout Myanmar for the same purpose.

Paratypes. MYANMAR. **Mandalay Division:** Dhazi Township, Otwin Village, elev. 300 m, 20°49′05″N, 96°23′02″E, 12 July 1998, *W. J. Kress 98–6177* (US); Pyin-Oo-Lwin Township, Peik Chin Myang Caves, elev. 750 m, 22°06′04″N, 96°37′05″E, 01 July 1999, *W. J. Kress 99–6488* (DUKE, RAF, US); Pyin-Oo-Lwin Township, Dat Taw Gyaik Water Fall, elev. 800 m, 21°58′43″N, 96°33′10″E, 03 July 1999, *W. J. Kress 99–6507* (DUKE, RAF, US); Thabeikyin Township, Shwe-U-Daung National Park, elev. 800 m, 22°55′24″N, 96°09′50″E, 12 June 2001, *W. J. Kress 01–6908* (K, MO, RAF, US). U.S.A. **Maryland:** Suitland, NMNH Department of Botany Research Greenhouses, 18 Aug. 2000, *W. J. Kress 00–6749* (US). Plants are also in cultivation in the Department of Botany Research Greenhouses at the National Museum of Natural History (US) and at the Queen Sirikit Botanical Garden in Chiang Mai, Thailand.

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Miscellaneous Mistletoe Notes, 37–47

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ABSTRACT. The following new species are proposed: *Cladocolea nitida* Kuijt, *C. peruviensis* Kuijt, *Struthanthus andersonii* Kuijt, *S. lewisii* Kuijt, *S. longibracteatus* Kuijt, and *S. tortistylus* Kuijt (Loranthaceae), *Dendrophthora equisetoides* Kuijt, *D. harlingii* Kuijt, and *D. meridana* Kuijt (Viscaeae). Additionally, two transfers are made, one to *Cladocolea, C. alternifolia* (Eichler) Kuijt (Loranthaceae), and one to *Dendrophthora, D. warmingii* (Eichler) Kuijt.

Key words: *Cladocolea, Dendrophthora,* Loranthaceae, Neotropical, *Struthanthus,* Viscaceae.

This paper, like the earlier ones in this series as cited below, presents a number of new taxa and new combinations and related elucidations that are not part of my continuing monographic studies of the two main mistletoe families (Loranthaceae and Viscaceae) of the New World. The earlier installments are found in Kuijt (1980, 1987) and Kuijt and Kellogg (1996).

LORANTHACEAE

37. Cladocolea alternifolia (Eichler) Kuijt, comb. nov. Basionym: *Phthirusa alternifolia* Eichler, Flora Brasil. 5(2): 66. 1868. TYPE: Brazil. Rio de Janeiro: Copacabana, 29 Oct. 1867, *A. F. M. Glaziou 2142* (lectotype, designated by Kuijt (1994b), BR; isolectotypes, B, P.) Figures 1, 2.

AMENDED DESCRIPTION:

Rather densely leafy, glabrous, sympodial, the apex aborting and 1 to 3 axillary buds of the uppermost leaves continuing growth. Stems slightly angular when young, soon becoming terete. Leaves to 9 × 4 cm, ovate, apex acute, often somewhat attenuate, base obtuse, petiole ca. 3 mm, flattened and winged above, venation pinnate; phyllotaxy alternate throughout. Inflorescence, including the flowers, no more than 3 mm long, often 2 or 3 per leaf axil, consisting of 3 to 5 flowers on a short axis of < 0.5 mm, each flower subtended by a smooth-margined bract. Flowers possibly bisexual, rounded in bud, ca. 2 mm long. Petals 6, nearly 2 mm long, dimorphic, anthers with 4 thecae, upper anthers somewhat shorter than lower ones, style the full length of the flower, the upper portion more slender, compressed between anthers in the bud; nectary ring 6-angled.

N. B. Van Tieghem (1895: 172) listed "*alternifolia* (Eichl.)" as a candidate for inclusion in the genus *Passowia* Karsten but did not actually make that combination. This genus has not been accepted by subsequent workers but, in Van Tieghem's usage, corresponds to present-day *Phthirusa,* differing from *C. alternifolia* in its triadic inflorescences and unusual stamen morphology (see Kuijt & Kellogg, fig. 11).

The base of the plant is not included in any of the material I have seen. It is not known, therefore, whether basal epicortical roots are developed.

The inflorescence in *Cladocolea alternifolia* is so small and short that the question may well be asked whether the flowers are not separately sessile in the leaf axil, as in *Ixocactus.* This is not so, however, as the entire unit is attached at a single point, and we therefore have an inflorescence before us (Fig. 1b–e).

There is a striking overall similarity between this rare species, and the even more rare *Ixocactus macrophyllus* Kuijt from Bahia (Kuijt, 1994a). The two species have very similar leaves as well as miniscule flowers crowded into the leaf axils. Upon closer scrutiny, however, the structural differences loom large. *Ixocactus macrophyllus* has tetramerous flowers with isomorphic petals, a massive style terminating in a distinctive, capitate stigma, and its phyllotaxy is decussate. The present species has hexamerous flowers, strongly dimorphic petals and stamens, and its style is much more slender, the stigma indistinct. With regard to the stylar features, however, it must be remembered that we do not know these in the male flower of *I. macrophyllus*; neither do we know with certainty whether *C. alternifolia* is dioecious or whether it has bisexual flowers and, therefore, what the style and stigma of a female flower might look like.

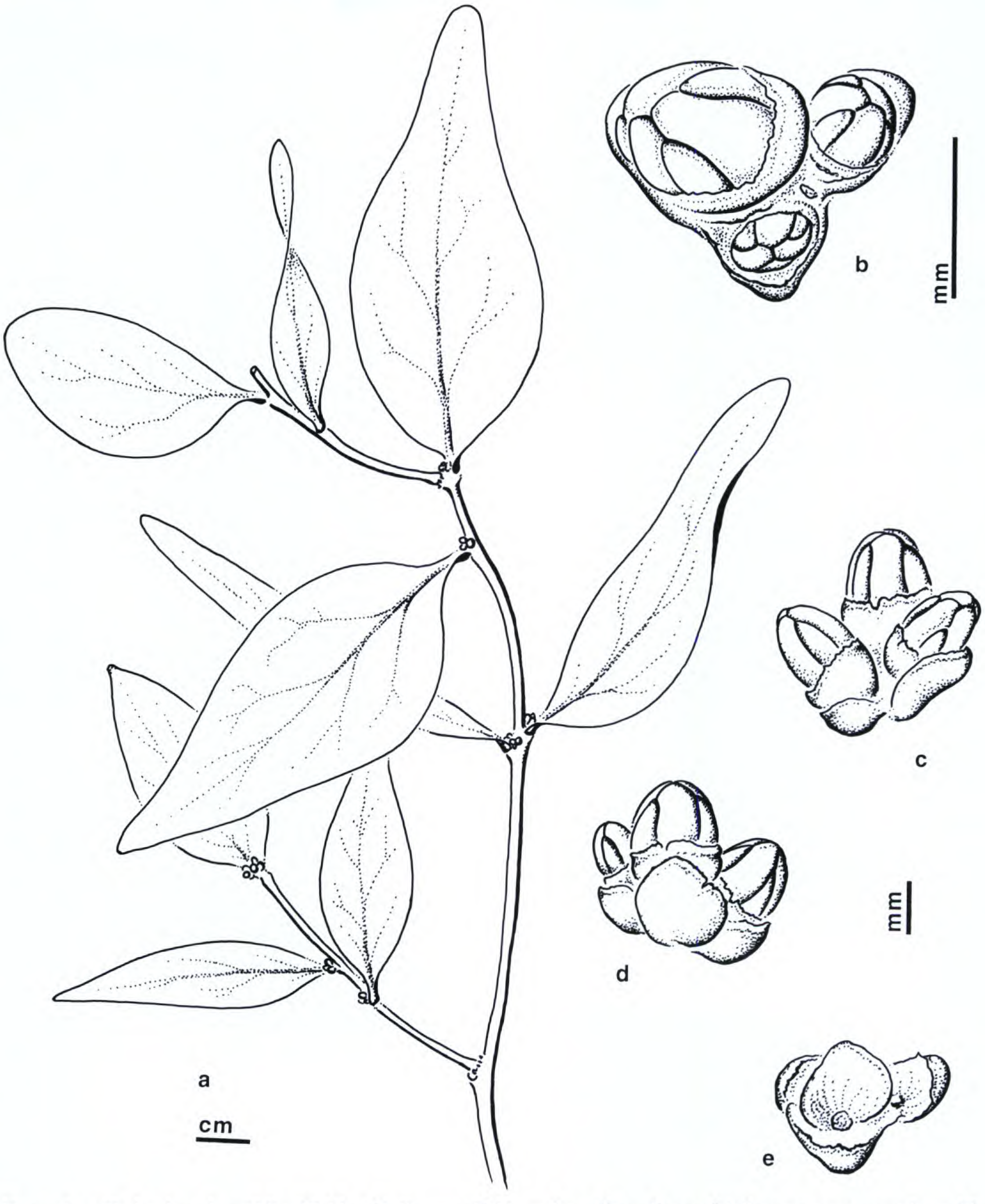

Figure 1. *Cladocolea alternifolia* (Eichler) Kuijt. —a. Habit. —b–e. Three-flowered inflorescence as seen from different directions, part e with flower buds removed to show the absence of bracteoles. Drawn from *Glaziou 4011* (P).

Following the present understanding of generic delimitations, there appears to be no other option but to place the species in *Cladocolea*, the only known small-flowered Neotropical genus in the family in which ebracteolate inflorescences occur. Within that genus, however, *C. alternifolia* occupies an isolated position, both taxonomically and geographically. In terms of affinity as well as proximity, the nearest species may be *C. roraimae* (Steyermark) Kuijt from Mt. Roraima, Venezuela (Kuijt, 1975a; see also the comments under *C. peruviensis*, below).

Cladocolea alternifolia is now likely to be extinct; the only specimen collected since 1870

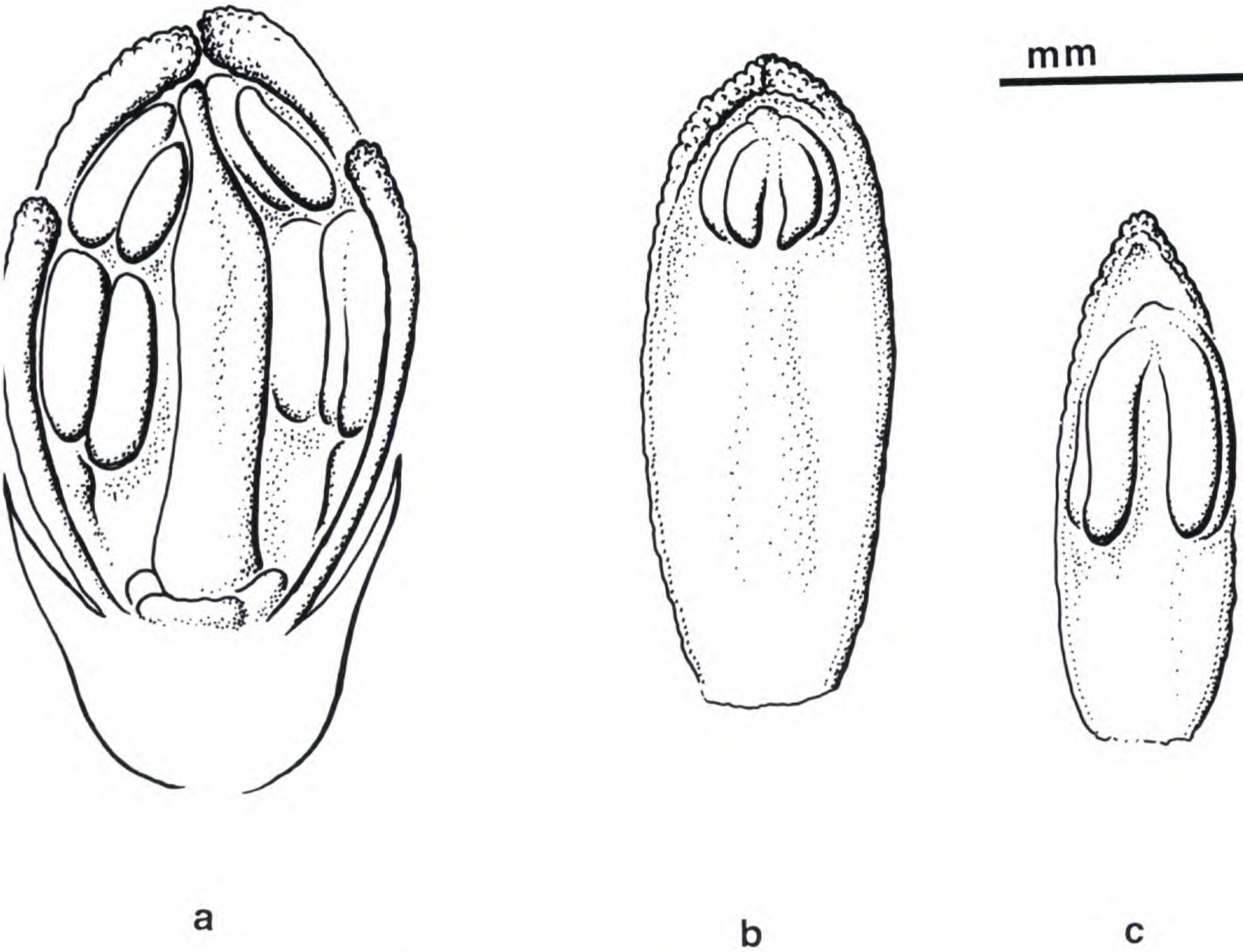

Figure 2. *Cladocolea alternifolia* (Eichler) Kuijt, floral dissection. —a. Mature bud, partly cut away, showing the natural position of elements. —b, c. Dimorphic petals and anthers. Drawn from *Glaziou 4011* (P).

seems to be *Apparicio & Brade 20118*, São Paulo, Serra da Bocaina, on Monimiaceae (RB), which I have not seen (Rizzini, 1956).

Additional specimens seen. BRAZIL. **Rio de Janeiro:** "versant de Copacabana," 26 Jan. 1870, *Glaziou 4011* (P), s.l., *Schott 4584* [with note "commé. par l'Herbier de Vienne," label written in Van Tieghem's hand, incl. "*Passowia alternifola*" and "*Phthirusa alternifolia* Eichler."]

38. Cladocolea nitida Kuijt, sp. nov. TYPE: Guyana. Potaro-Siparuni region: Pakaraima Mountains, Mt. Wokomung, ridgeline 0.5 km NE of Wokomung escarpment adjacent Ka-Mie-Wah pinnacle, 5°4′N, 59°53′W, 1400–1500 m, medium canopy cloud forest, 15 Nov. 1993, flowers light green, very fragrant, *T. W. Henkel, R. Williams, S. Fratello & P. Joseph 4400* (holotype, LEA; isotype, US). Figure 3.

Planta dioecia parce ramosa. Folia opposita, obovata, nitida. Inflorescentia determinata, ex floribus ebracteolatis sessilibus in monades 3 dispositis constans. Flos ca. 4.5 mm longus, petalis 5, stylo recto, stigmate capitato.

Plants dioecious, sparsely branched, glabrous, stems quadrangular at least when young. Leaves regularly paired, to 5 × 2 cm, of which the slender petiole is ca. 1 cm. Blade obovate, upper surface very shiny when dry, lower surface dull, the pinnate venation and minor venation clearly marked on both sides; apex rounded to notched or sometimes somewhat mucronulate; base acute. The type female; male plants not known. Female inflorescence 1 per axil, flanked by 2 acute prophylls becoming torn and corky with time, inflorescence including flowers 5 mm, determinate, consisting of 7 flowers in 3 decussate pairs plus 1 terminal one, all flowers ebracteolate, the lowest ones each subtended by one caducous bract 2 mm long, others apparently ebracteate. Flowers 4.5 mm long of which 1 mm ovary with flaring, entire calyculus; petals 5, each with minute, elongate, staminodial cushion; style nearly as long as petals, surrounded by nectary disk at base; stigma capitate, very prominent, 0.75 mm wide. Fruit not known.

Cladocolea nitida is closely related to *C. elliptica* Kuijt from Suriname (Kuijt, 1992), being similar in basic inflorescence structure and the curious, staminodial ridge. *Cladocolea elliptica*, however, has no evident venation, while *C. nitida* has shiny, rather thin leaves on which even the minor venation is

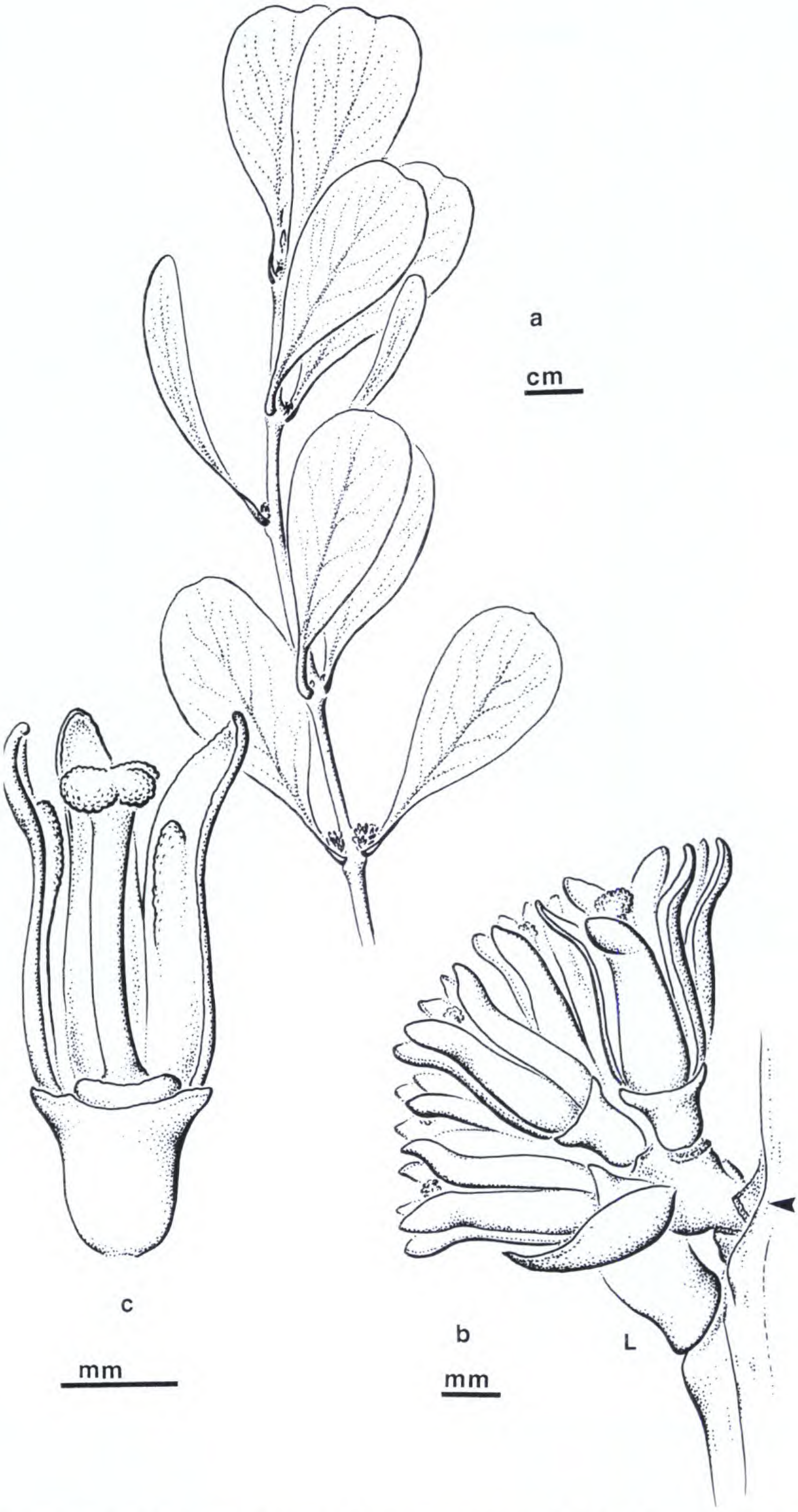

Figure 3. *Cladocolea nitida* Kuijt. —a. Habit. —b. Female inflorescence, 5 of the 7 flowers visible, in axil of foliage leaf (L); one floral bract is still in place. The arrow indicates a split, corky prophyll subtending the inflorescence. —c. Floral dissection of female flower, the nearest 2 petals removed. Drawn from *Henkel et al. 4400* (LEA).

visible in remarkable detail. *Cladocolea nitida* is pentamerous and has only single flowers in alternate positions, while *C. elliptica* is tetramerous and has at least some (paired) triads in the lowest positions in the inflorescence. Other striking differences are the absence of any scurfy surface even in the youngest twigs of *C. nitida*, and its extremely large stigma. *Cladocolea nitida* is known only from the type collection.

39. Cladocolea peruviensis Kuijt, sp. nov. TYPE: Peru. San Martín: Rioja–Pomacochas road, below Venceremos, ca. 20 km NW of Rioja near Restaurant El Amigo, 05°45′S, 77°38′W, 1600 m, 8 Feb. 1984, *A. Gentry & D. N. Smith 45173* (holotype, MO; isotype, LEA). Figure 4.

Planta dioecia. Innovationibus ut videtur determinatis. Folia opposita, lanceolata. Inflorescentia determinata, a floribus brevipedicellatis in monades 2 ad 6 dispositis constans. Flos petalis 4, antheris dimorphis.

Plants dioecious, stems somewhat angular-grooved to terete, lacking lenticels when leaf-bearing, internodes to 3 cm long, older nodes somewhat swollen, phyllotaxy paired; innovations with 3 to 8 pairs of leaves, after which the apex apparently aborts, primary axillary buds continuing growth the following season. Leaves to 10 × 5 cm, lanceolate to ovate, base of blade tapering into an indistinct petiole, which is flat and winged above, the wingless part 3–4 mm long; apex obtuse to acute but not attenuate; blade shiny above, dull below, venation pinnate with numerous lateral veins, the minor venation distinct above. The type male; female plants not known. Male inflorescence 7–9 mm long, most of which is flowers, on older growth only, at first subtended by several pairs of yellowish, papery bracts, the axis ca. 5 mm long, with 2 or 3(4) pairs of lateral, ebracteolate flowers and one terminal one, each with a pedicel ca. 0.6 mm long, the subtending bracts small and caducous; inflorescence base surrounded by corky crater; mature bud 4.5 mm long, of which ovary 1 mm, slender, calyculus nearly smooth; petals 4, 3.5 mm long, strap-shaped, scarcely dimorphic; anthers 1 mm long, sessile on upper part of petal, dimorphic, with 4 locules, connective not extending beyond pollen sacs, filament fused with petal, forming a downward ridge to near the base of the petal; style lacking, center of the flower with a flat cushion with papillar surface.

Paratypes. ECUADOR. **Zamora-Chinchipe:** area of Estación Científica San Francisco, around km 30 on road Loja–Zamora, E of Ceja Andina (3°58′18″S, 79°4′44″W); moist montane forest, on Meliaceae, 1800 m, *Bussman et al. 12594* (MO). PERU. **Cajamarca:** San Ignacio, San José de Lourdes, base of Cerro Picorana, remains of Andean forest, 45°9′25″S, 78°54′15″W, 2010 m, *Díaz & Fernández 10152* (LEA).

The sexual status of *Bussman et al. 12954* is uncertain, but it is said that the berries are black; the other specimens seen are male.

Surprisingly, considering the 2000 km across the Amazon basin separating provenances, the most convincing affinities of the new species *Cladocolea peruviensis* appear to be with *C. roraimensis* (Steyermark) Kuijt, which is known only from Mt. Roraima (Kuijt, 1975a). Both species have very short, determinate inflorescences subtended by several pairs of stiff, chartaceous bracts and bearing 5 to 9 flowers, which at least initially are subtended by one bract each but lack bracteoles. Floral structure is also remarkably similar: male flowers are tetramerous and bear minute, completely sessile anthers and, most unusual of all, have no aborted style, its place being taken by a central, basal cushion that may be a nectary. Notwithstanding such evidence of close affinity, the differences more than warrant specific separation: *C. roraimensis* has very thick, coriaceous leaves elliptic to ovate in shape and with obscure venation, while *C. peruviensis* has thin, broadly lanceolate leaves with evident, pinnate venation. Additionally, the flowers of the former are sessile and have a smooth basal cushion, and those of the latter are short-pedicellate with a papillate basal cushion. The affinity of *C. alternifolia* from easternmost Brazil to *C. roraimensis*, as mooted under No. 37 above, renders the suggested *C. peruviensis–C. roraimensis* affinity even more intriguing.

A second possible relative of *Cladocolea peruviensis* is *C. archeri* (Smith) Kuijt, which ranges from northern Peru to northern Colombia and so far is the most southerly member of the genus. However, close scrutiny reveals a number of significant contrasts, the most prominent of which is the dioecy of *C. peruviensis*. Additionally, the latter's inflorescence is much smaller than that of *C. archeri*, which may reach 5 cm; *C. peruviensis* also has fewer flowers, which, moreover, are pedicellate rather than sessile. The prominent lenticels that characterize young internodes of *C. archeri* likewise are absent in *C. peruviensis*. Nevertheless, the determinate inflorescence, tetramerous flowers, and the basal chartaceous scales of the inflorescence in the new species strongly indicate an affinity with *C. archeri*. A species more remotely related may be *C. coriacea* Kuijt, which also has tetramerous flowers and possibly has similar male flowers lacking styles (Kuijt, 1987). Its flowers are also pedicellate, but the inflorescence is indeterminate and not subtended by chartaceous scales.

Figure 4. *Cladocolea peruviensis* Kuijt. —a. Habit: upper portion of innovation. —b. Apex of innovation, apparently aborting, with 2 axillary inflorescences in bud, and 2 of the 4 associated buds. —c. Dissection of mature male bud, the nearest petal removed. Drawn from *Gentry & Smith 45173* (LEA).

40. Struthanthus andersonii Kuijt, sp. nov. TYPE: Brazil. D.F.: trail to Cachoeira do Tororó, ca. km 10, area near IBGE Ecological Reserve, left of name plate of Fazenda Santa Prisca, *R. Marquete, A. Vaz, V. L. G. Klen, L. Silvestre & D. Alvarenga 2587* (holotype, LEA; isotype, IBGE not seen). Figure 5.

Planta dioecia, internodia teretia, 3–6 cm longa. Folia 10 × 3 cm, lanceolata, venatione manifeste pinnata, apice acuta, basi obtusata, petiolo manifesto usque ad 1 cm longo. Inflorescentia usque ad 1 cm longa, ex floribus sessilibus in triades unijugas dispositis constans; bracteis persistentibus. Alabastrum 3–5 mm longum.

Plants dioecious, internodes 3–6 cm, terete; the base of innovations and inflorescences surrounded by corky craters. Leaves to 10 × 3 cm, lanceolate, apex acute to somewhat attenuate, base abruptly contracted to truncate, petiole to 1 cm, distinct; venation pinnate, evident. Inflorescences < 1 cm, peduncle 2–4 mm, arising in clusters in leaf axils of older growth only, bearing 2 sessile triads, bracts and bracteoles persistent even in fruit. Male buds strongly clavate, 3–5 mm, the tip 2 mm wide and very blunt, calyculus finely dentate, stamens dimorphic, anthers 1 mm, without connectival horn, filaments rather stout, extending down on the petal as a fleshy ridge; style 1.5 mm, very slender, stigma undifferentiated. Female buds narrowly cylindrical, petals 4 mm, linear, calyculus as in the male, sterile anthers and filaments distinct, minute, dimorphic, style straight, nearly as long as the petals, stigma distinct, capitate. Fruit 4.5 × 2.5 mm, ellipsoidal.

The new species *Struthanthus andersonii* may be related to *S. confertus* (Martius) Martius in that it has very similar inflorescences, but it has a very different leaf shape and, unlike the latter species, seems to flower only on older wood, new innovations being sterile. The species also shows a great deal of similarity to *S. vulgaris* (Martius) Martius, but its leaves are longer, it has smooth rather than lenticel-dotted internodes, its flowers are sessile, and both bracts and bracteoles are persistent even in fruit. The Costa Rican species *S. quadrangularis* Kuijt is also somewhat similar but has strongly quadrangular stems, obscure lateral venation, and 2 to 3 pairs of triads (Kuijt, 1990).

Struthanthus andersonii is named after the co-collector of one of the paratypes, William R. Anderson of the University of Michigan, renowned specialist on Malpighiaceae.

Paratypes. BRAZIL. **Goiás:** Serra Geral do Paraná, 3 km by road S of São João da Aliança, cerrado and gallery forest along river, 1040 m, *W. R. Anderson et al. 7773* (LEA, NY). **Espírito Santo:** Linhares, Reserva Florestal de Linhares, aceiro, Cateln-Jueir, km 0, *D. A. Folli 2049* (LEA).

41. Struthanthus lewisii Kuijt, sp. nov. TYPE: Bolivia. La Paz: Inquisivi Prov., along the road between Miguillas and the cumbre between the Río Miguillas and the Río La Paz, deciduous forest, 16°32′S, 67°22′W, 1300–1800 m, 30 Dec. 1989, *M. Lewis 36955* (holotype, MO not seen; isotypes, LEA, LPB not seen). Figure 6.

Planta dioecia, sat parva, tomentosa, caulibus gracilibus. Folia tenua, ovata, venatione manifeste pinnata, apice acuta, basi obtusa vel truncata. Inflorescentia mascula axillaris, solitaria, 3–5 cm longa, ex floribus sessilibus in triades bi- vel trijugas dispositis constans; bracteis bracteolisque persistentibus. Flos masculus alabastro ca. 5 mm longo, parte principali ellipsoidali.

Dioecious, slender, small-leaved, much-branched plants, even the youngest leaf blades glabrous, but petioles and stems (including those of the inflorescence) densely white-, short-tomentose, internodes 4–6 cm, terete, with epicortical roots; vegetative laterals with 1 to 3 pairs of short, blunt to acute basal scale-leaves. Foliage leaves to 4.5 × 2 cm, thin, ovate, apex acute, base truncate or nearly so, midvein distinct, running into apex, venation pinnate. Female plant and fruit not known. Male inflorescence 3–5 cm, slender, possibly subtended by small, caducous leaf scales but without any basal crater, peduncle 1–2 cm, keeled to somewhat angular; triads in 2 or 3 pairs, triad peduncles 3–4 mm, bracts and bracteoles deltoid, of comparable size, persistent; buds 5 mm, hexamerous, 1 mm of which is the ovary, the upper 2/3 fusiform, tip ± acute, calyculus reflexed at least when dry, with numerous short marginal hairs; stamens strongly dimorphic, anthers 1 mm, versatile, the lower series with well-developed, acute connectival horn.

To my knowledge, only one other South American small-flowered member of Loranthaceae develops an indumentum, sharing that character with *Struthanthus lewisii*. This is *Phthirusa trichodes* Rizzini, a very different, curious species of Venezuela, Guyana, and adjacent Brazil, which has inflorescences with two sessile triads each, these bearing sessile, tetramerous flowers.

42. Struthanthus longibracteatus Kuijt, sp. nov. TYPE: Peru. Madre de Dios: Manu, Parque Nacional de Manu, Río Manu, Cocha Cashu Station, floodplain forest, 11°50′S, 71°25′W, 350 m, on *Tessaria, R. Foster 9846* (holotype, MO not seen; isotype, LEA). Figure 7.

Planta dioecia, glabra, caulibus gracilibus, teretibus.

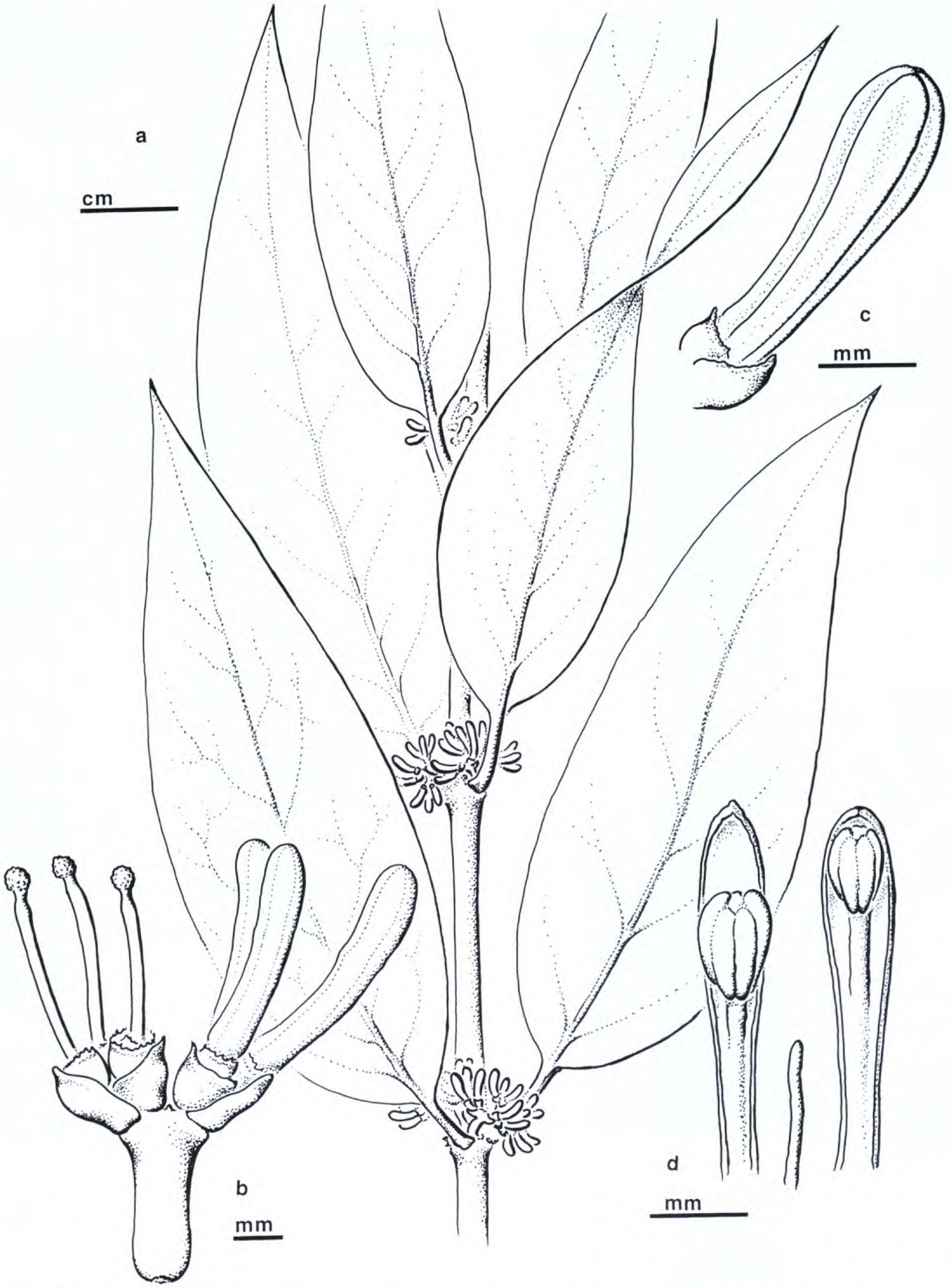

Figure 5. *Struthanthus andersonii* Kuijt. —a. Habit. —b. Female inflorescence. —c. Male bud. —d. Dissected floral organs of male flower. Drawn from *Marquete et al. 2587* (LEA).

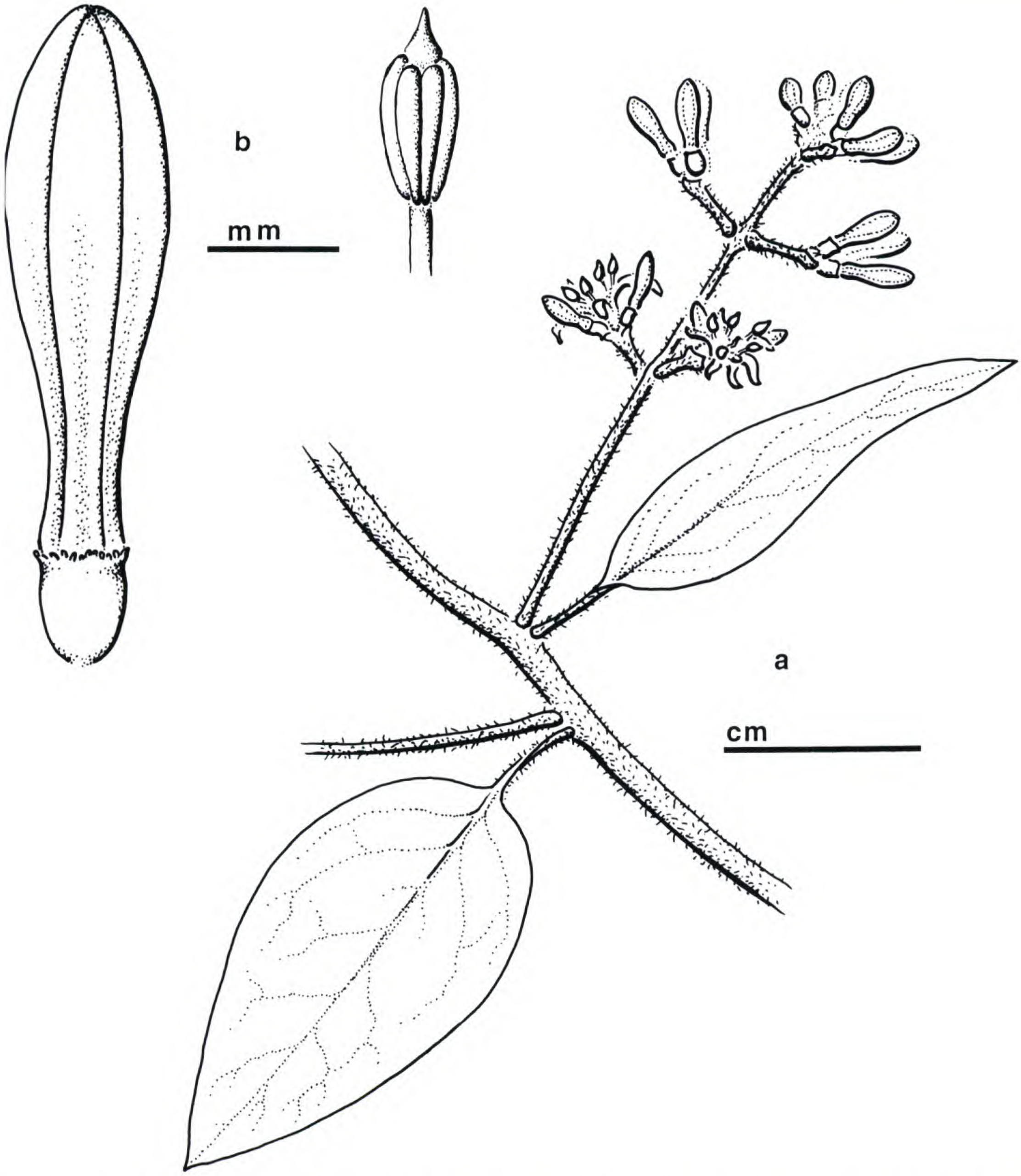

Figure 6. *Struthanthus lewisii* Kuijt. —a. Habit of male plant. —b. Mature male bud and lower anther. Drawn from *Lewis 36955* (LEA).

Folia tenua, usque ad 7 × 2.5 cm, lanceolata vel elliptica, venatione pinnata, apice obtusa, petiolo gracili usque ad 1.5 cm longo. Inflorescentia usque ad 5 cm longa ex floribus in triades bi- vel trijugas dispositis constans; bracteis 2–3 mm longis, recurvatis, interdum foliaceis; bracteolis loriformibus.

Slender, dioecious, glabrous plants, internodes terete, 5–7 cm, with occasional epicortical roots. Leaves to 7 × 2.5 cm, thin, lanceolate to elliptical, apex obtuse, base acutely tapering into slender petiole to 1.5 cm; venation pinnate, midvein running into apex. Female inflorescence to ca. 5 cm, the two minute prophyllar bracts mostly moved upward on the inflorescence axis for 4–7 mm and caducous, but sometimes remaining at the base, usually followed by a second pair of minute, caducous scale leaves somewhat higher; triads in 2 or 3 pairs, on the upper half of the inflorescence, triad peduncle to 4 mm, primary

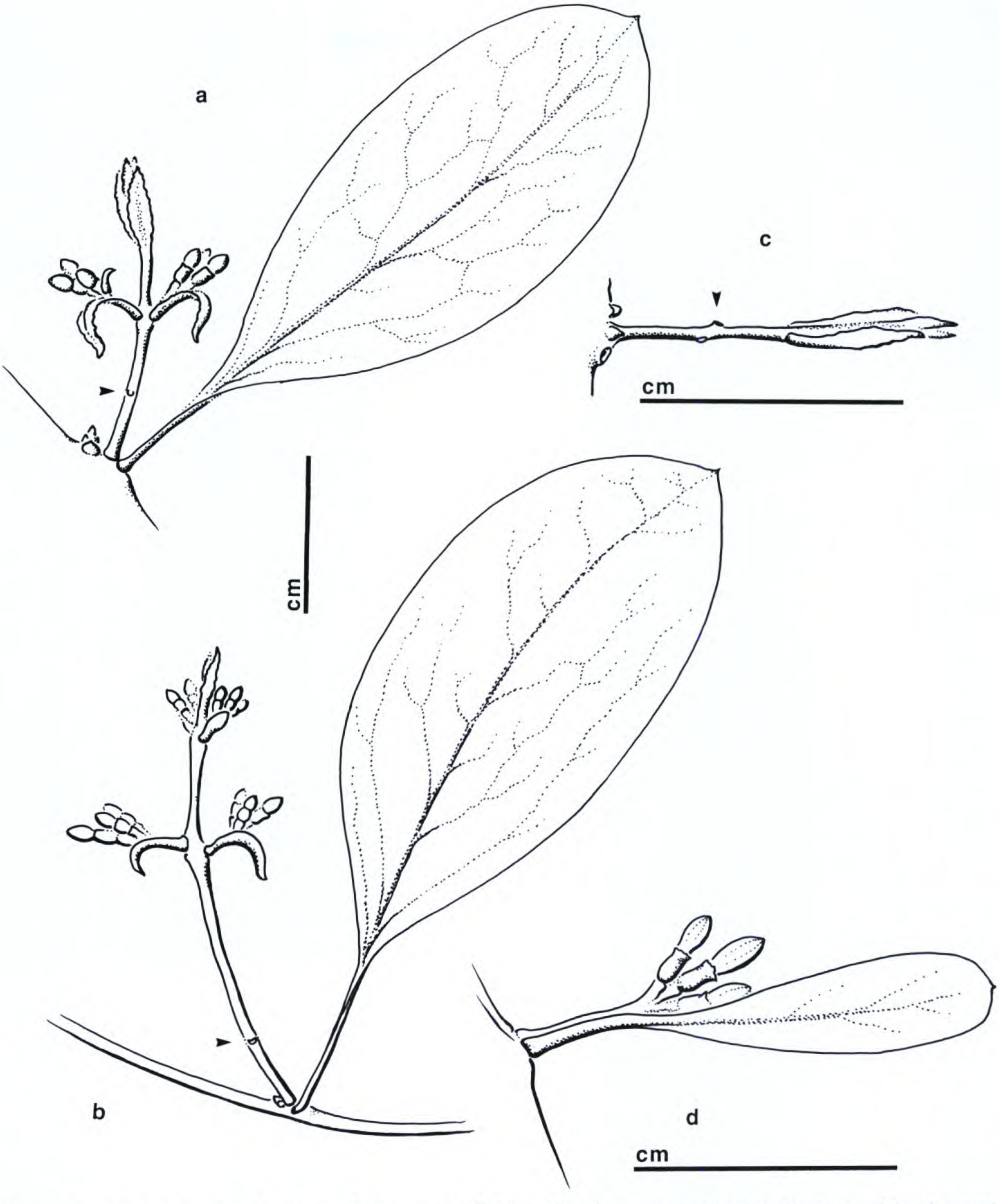

Figure 7. *Struthanthus longibracteatus* Kuijt. —a, b. Habit, with inflorescences in two early stages of development. —c. Very young axillary inflorescence, the triad bracts still erect and obscuring the flower buds. Arrows indicate bracts or bract scars on peduncles. —d. Female inflorescence triad with foliaceous primary bract. Drawn from *Foster 9846* (LEA).

bract acicular, 2–3 mm long, recurved, persistent; flowers on pedicels ca. 2 mm long, lateral ones with narrow, strap-like, caducous bracteoles; flower buds 4 mm long, half of which is a cylindrical ovary, calyculus with short-papillate margin; primary bract sometimes foliar and to 14 mm long. Male plant and fruit not known.

One of the most distinctive species of *Struthanthus*, with a unique leaf shape, and long, acicular bracts, which, in contrast to the bracteoles, are persistent. Known only from the type, which, unfortunately, does not have fully developed buds, denying us the possibility of further morphological details.

43. Struthanthus tortistylus Kuijt, sp. nov. TYPE: Ecuador. Pastaza: Kapawí (Amuntai), Río Pastaza, on pasture tree, 2°31′S, 76°48′W, 235 m, 14–20 July 1988, *W. H. Lewis, M. Elvin-Lewis, C. E. Cerón, E. J. Kennelly & M. C. Gnerre 13615* (holotype, MO; isotype, LEA). Figure 8.

Planta dioecia, robusta, glabra, caulibus teretibus. Folia ovata, usque ad 10 × 4.5 cm, venatione pinnata, apice attenuata, basi obtusa, petiolo ca. 1 cm longo. Inflorescentia feminea ca. 4 cm longa, squamis basalibus bijugis subtenta, a floribus sessilibus in triades ca. 4-jugas tum monades uni- ad trijugas tum florem terminalem solitarium dispositis constans. Flos feminea stylo contortissimo.

Rather large, dioecious, glabrous plants, internodes 3–8 cm, terete. Leaves to 10 × 4.5 cm, shiny when dry, apex attenuate, base obtuse, petiole 1 cm, distinct; venation pinnate, even the minor venation evident, midvein running into apex, with four basal lateral veins running 4/5 of the length of the blade. Male plant not known. Female inflorescence ca. 4 cm, without basal crater but subtended by 2 or more small, blunt, partly caducous leaf scales; axis angular, peduncle 4–6 mm, followed by about 4 pairs of triads and 1 to 3 pairs of ebracteolate monads and a single terminal flower; triads and flowers sessile, bracts and bracteoles caducous. Flower 3.5 mm, ovary 1 mm, sterile anthers extremely small, ovate, essentially sessile. Style perhaps twice as long as the petals, tightly contorted even after anthesis; stigma large, capitate. Fruit (immature) ovoid, apex blunt, calyculus irregularly dentate. Male plant not known.

The curiously contorted style of *Struthanthus tortistylus* is a unique feature in South American Loranthaceae. A Brazilian species of *Phthirusa, P. cochliostyla* Ule, comes to mind because of its specific epithet but, although its type is no longer extant, it is clearly a (male) *Phthirusa,* now synonymized under *P. stelis* (L.) Kuijt (Kuijt & Kellogg, 1996). It is only in Mexican species of *Struthanthus* (Kuijt, 1975b) and *Cladocolea* (Kuijt, 1975a) that comparable styles exist. The styles of male flowers in those species are also contorted, but somewhat less so than in the female; the same may be expected in *S. tortistylus.* In all cases, the configuration of the style remains unaltered throughout anthesis until the style falls away afterwards. The functional meaning of this feature is puzzling, but may somehow be connected to the bizarre behavior of the embryo sac, which, in Loranthaceae, grows into the style, where fertilization takes place (Kuijt, 1969; Venturelli, 1981).

Actual relationships of *Struthanthus tortistylus,* rather than with any Mexican species, seem to be with *S. leptostachyus* (Kunth) G. Don and *S. polystachyus* (Ruiz & Pavón) G. Don. This is suggested by the occurrence of ebracteolate monads and a terminal flower on the inflorescence; additionally, the sessile triads and flowers and the caducous basal inflorescence scales and triad bracts are held in common by these three species.

VISCACEAE

44. Dendrophthora equisetoides Kuijt, sp. nov. TYPE: Ecuador. Napo-Pastaza: Mera, *M. Lugo 121* (holotype, S). Figure 9.

Planta gracilis, ramosissima, aphylla, monoecia, caulibus teretibus. Inflorescentia terminalis ex internodiis fertilibus 1 ad 3, inferioribus masculis summa feminea flores bi- vel triseriatos gerentibus constans. Bacca in diam. 4 mm, subglobosa, usque ad 4 mm in diam.

Monoecious plants, squamate, divaricate, mostly percurrent but with (apparently only) terminal inflorescences; internodes to 4.5 cm long, slender, terete; basal cataphylls one rather small pair 3–7 mm above the base, not tubular. Inflorescences subtended by 1 to 5 vegetative internodes (beyond basal cataphylls), and consisting of 1 to 3 fertile internodes, the terminal female, the remaining one(s) male; male fertile internodes ca. 13 mm long, female ones to 20 mm; male flowers ca. 11 per series, exceedingly small, anthers unilocular, female flowers to ca. 8 per series, on a somewhat swollen fertile internode; both male and female flowers biseriate or triseriate, even on the same inflorescence. Fruit ca. 4 mm diam., somewhat depressed-globose, petals very small, parted to erect.

Dendrophthora equisetoides is a truly extraordinary species, known only from the holotype, and with no evident relatives in the genus, although its sex distribution is similar to that of *D. clavata* (Bentham) Urban and, perhaps more to the point, to the *D. basiandra* Kuijt illustrated in Kuijt (1986, fig. 41), which is now known as *D. macbridei* (Standley) Kuijt (Kuijt, 2000). I have seen no evidence of anything but terminal inflorescences, which would be unique at least in South American species of the genus. *Dendrophthora equisetoides* shows a striking general resemblance vis-à-vis some Caribbean *Dendrophthora* species such as *D. domingensis,* but its peculiar inflorescence construction is at once distinctive. Even though the flowers are excessively small, the anther is clearly unilocular.

45. Dendrophthora harlingii Kuijt, sp. nov. TYPE: Ecuador. Morona-Santiago: end of road

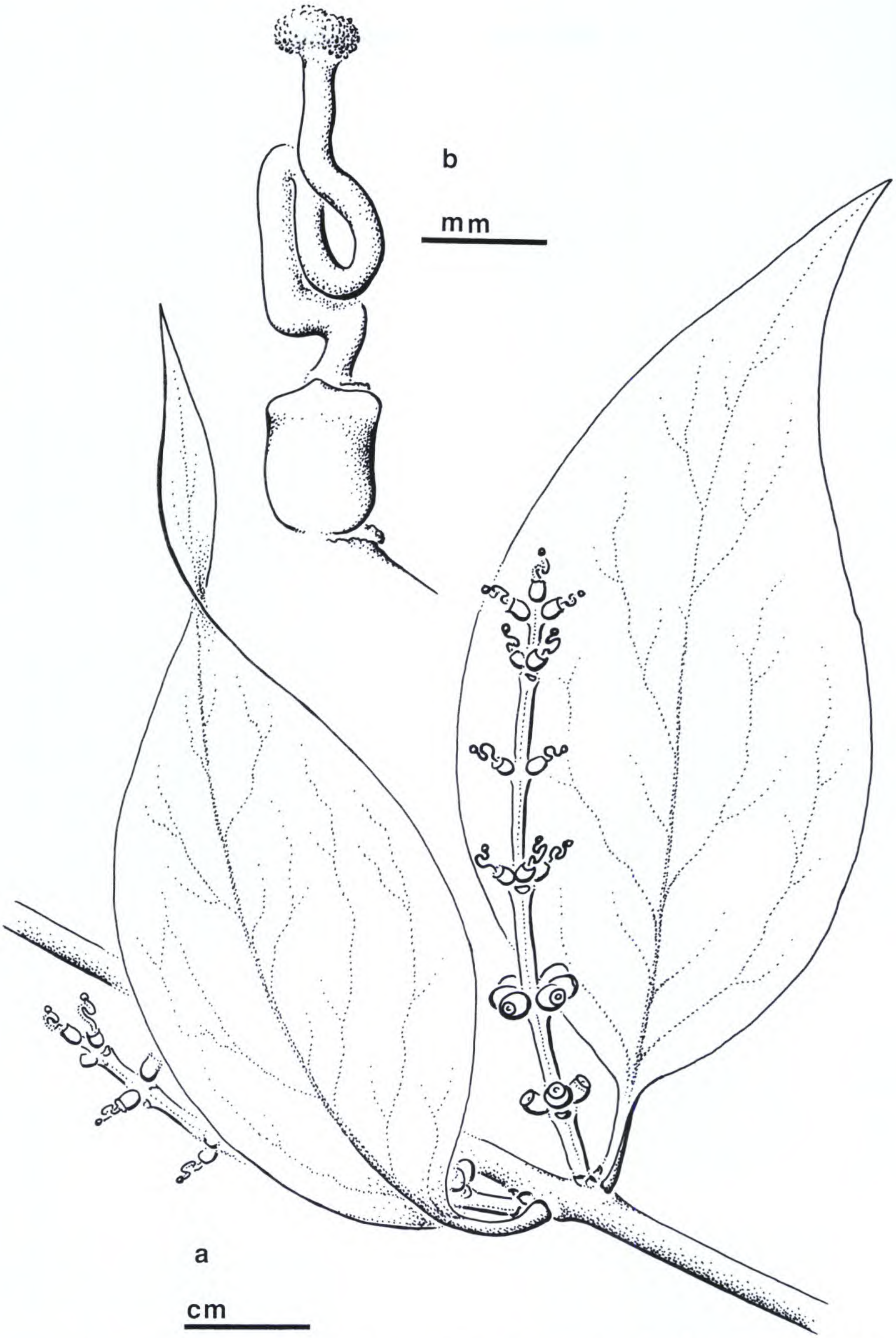

Figure 8. *Struthanthus tortistylus* Kuijt. —a. Habit. —b. Ovary and style. Drawn from *Lewis et al. 13615* (LEA).

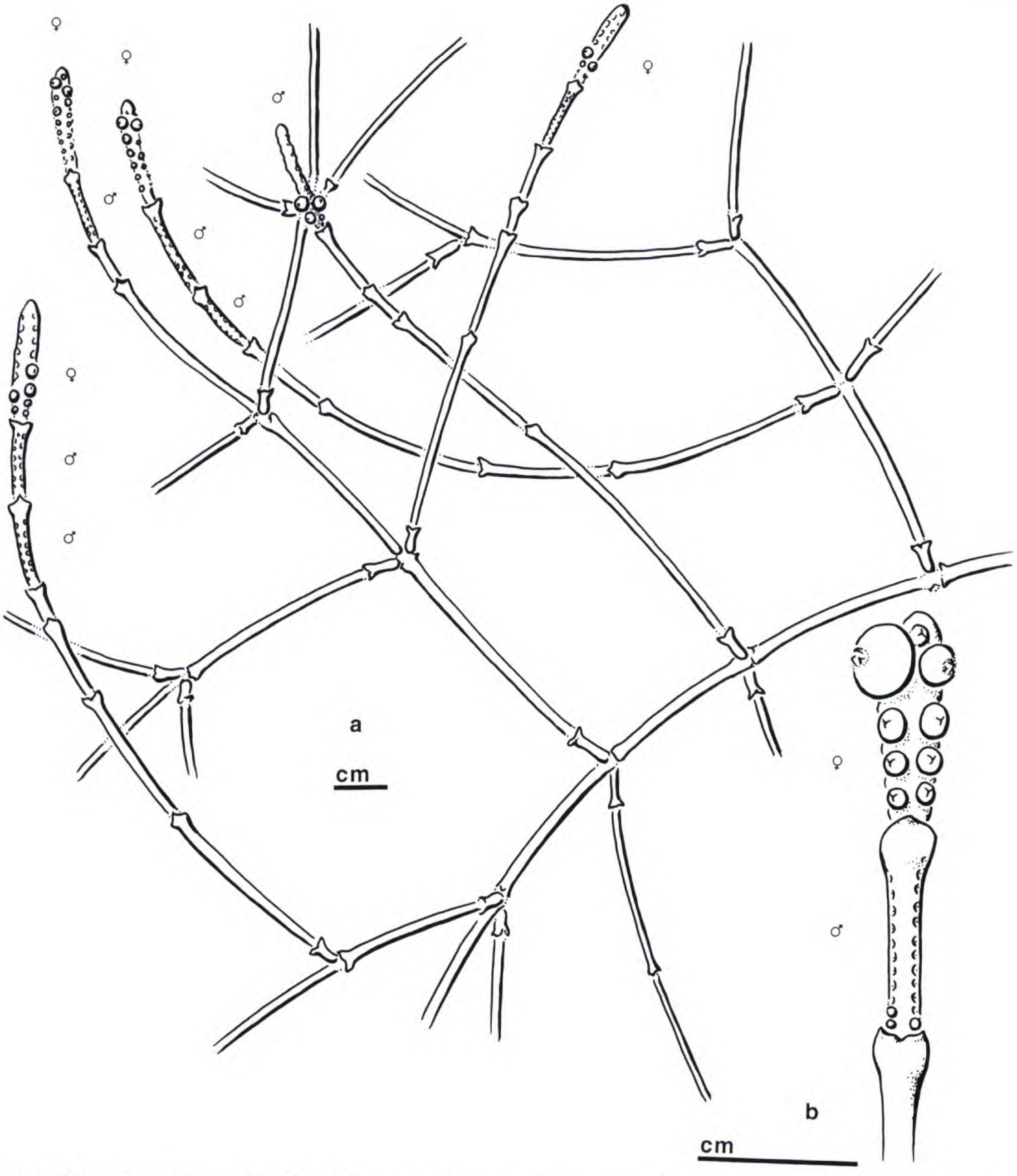

Figure 9. *Dendrophthora equisetoides* Kuijt. —a. Habit. —b. Inflorescence, the terminal fertile internode female, the basal one male. (♀ = female internode, ♂ = male internode.) Drawn from *Lugo 121* (S).

in construction, Limón–La Unión, ca. 10 km from Limón, primary moist forest, 1400 m, on *Ochroma*, 27 Feb. 1993, *G. Harling & B. Stahl 26727* (holotype, S). Figure 10.

Planta glabra subcarnosa, dioecia. Cataphylla basalia unijuga; folia usque ad 4 × 2.5 cm, obovata vel late cuneata. Inflorescentia mascula usque ad 1.5 cm longa ex internodio fertili solitario constans, floribus triseriatis usque ad 50 unaquaque bractea fertili subtentis. Inflorescentia feminea usque ad 1 cm longa ex internodio fertili solitario constans, floribus 3 unaquaque bractea fertili subtentis.

Plants dioecious, glabrous, somewhat succulent, internodes mostly to 5 cm, ± terete to very slightly keeled; basal cataphylls one rather inconspicuous pair, 2–5 mm above the base. Leaves to 4 × 2.5 cm, obovate to broadly cuneate, apex rounded to slightly emarginate, base acutely tapering to short (ca. 2 mm), indistinct petiole; venation obscure but

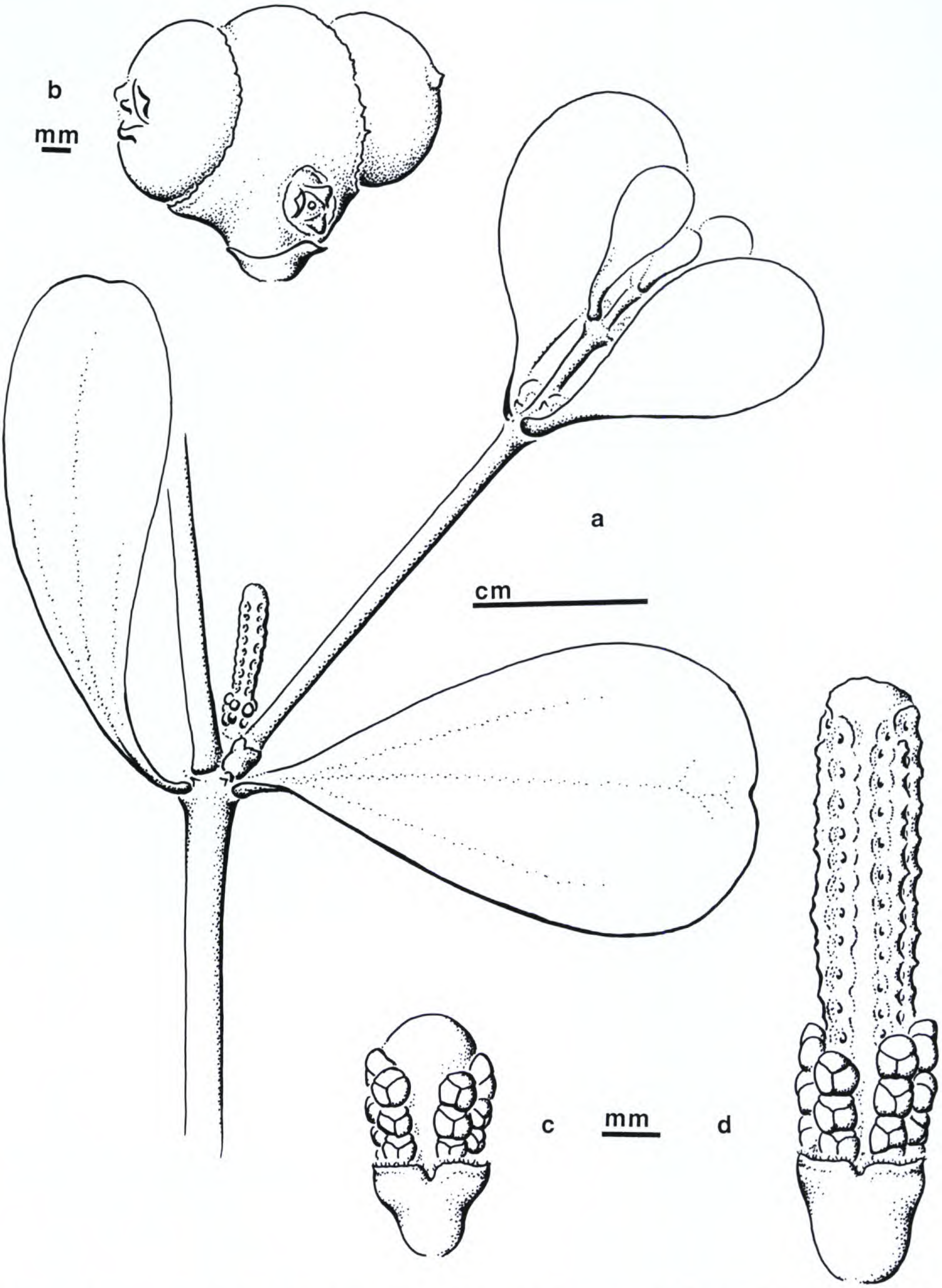

Figure 10. *Dendrophthora harlingii* Kuijt. —a. Habit. —b. Female inflorescence with 2 mature fruits. —c. Young male inflorescence. —d. Older male inflorescence. Drawn from *Harling & Stahl 26727* (S).

the midvein flanked by two major basal veins. Both male and female inflorescence types with very short, simple peduncle 1–2 mm, followed by one fertile internode. Male inflorescence < 1.5 cm long, flowers to 50 per fertile bract, regularly triseriate, the terminal, exhausted part of the fertile internode becoming rod-like. Female inflorescence < 1 cm long, flowers mostly 3 per fertile bract, the fertile internode swollen to 6 mm in fruit, and investing the bases of at least the young fruits. Fruits about 1 cm in width, longitudinally compressed, in shape a thick, rounded disk, white, with small, recurved petals.

Dendrophthora harlingii is a species closely related to *D. dalstroemii* Kuijt, but with some sharp differences. *Dendrophthora dalstroemii* has irregularly uniseriate flowers, the inflorescence peduncle making up about half of the length of the entire inflorescence, which mostly has 2 fertile internodes; it lacks basal cataphylls; and its leaves are consistently ovate rather than obovate. Finally, its fruiting internode does not show the distinctive swelling that characterizes *D. harlingii*.

Dendrophthora harlingii is perhaps more closely related to *D. cuneifolia* Kuijt from Venezuela (Kuijt, 1990), which, in general appearance, resembles it strikingly. *Dendrophthora cuneifolia* is monoecious, however, with unisexual inflorescences of both types occurring even on the same twig. Additionally, that species bears to 30 or more female flowers per fertile internode, and the flower seriation of the male inflorescence soon becomes irregular, while it remains strictly triseriate in *D. harlingii*, even on old inflorescences. The fruit of *D. harlingii* also appears much larger, and longitudinally compressed rather than more or less globular, but the shape of fruits is difficult to ascertain from herbarium material. Finally, inflorescence peduncles in *D. cuneifolia* may be up to 1 cm long, while those of *D. harlingii* rarely exceed 1 mm; and basal cataphylls are absent in the former, present in the latter.

Yet another species that may well be related is *Dendrophthora virgata* (Trelease) Kuijt as illustrated in Kuijt (1980), which differs in having male and female inflorescence peduncles to 6 mm long, to 10 flowers per female fertile bract, and much smaller (< 4 mm) leaves.

Paratype. As the type, *Harling & Stahl 26737* (S).

46. Dendrophthora meridana Kuijt, sp. nov. TYPE: Venezuela. Trujillo, border with Lara: Parque Nacional Dinira, Páramo de Jabón, fila cerca de la cumbre del Pico Jabón, shrubby páramo vegetation between boulders and rocky escarpments, 9°34′24″N, 70°07′03″W, 3100 m, 14 Aug. 1999, *R. Riina, R. Duno, R. Ghinaglia & R. Gonto 623* (holotype, VEN 301604). Figure 11.

Planta monoecia, glabra, erecta, sat carnosa, caulibus teretibus; cataphylla basalia nulla; folia usque ad 13 × 3 mm, oblanceolata. Inflorescentia mascula in axilla prophylli posita, floribus triseriatis usque ad 18 unaquaque bractea fertili subtentis. Inflorescentia feminea in axilla folii posita, floribus 4(6) triseriatis unaquaque bractea fertili subtentis.

Rigidly erect, glabrous, monoecious plants ca. 30 cm in height, densely branched, internodes to 2.5 cm long, terete, basal cataphylls absent, basal phyllotaxy transverse. Leaves to 13 × 3 mm, oblanceolate, fleshy, apex obtuse or nearly so, base cuneate, petiole indistinct; venation obscure. Inflorescences with separate sexes, to ca. 12 mm long, triseriate, peduncles 4 to 5 mm, simple, fertile internode one. Male inflorescences in secondary positions or lowest on lateral branches, to 10 mm long, flowers to about 18 per fertile bract. Female inflorescence mostly in primary axillary positions, flowers 4(6) per fertile bract. Fruit 2 × 2 mm, globose, white, petals spreading.

The small-flowered species of *Dendrophthora*, especially in the Bolivian and Venezuelan Andes, are in great need of revision, and the present species resembles a number of those that have already been described. The known and similar species differ from *D. meridana* in characteristics involving basal cataphylls, number of flowers per fertile bract, the number of fertile internodes per inflorescence, in being short-tomentose, and in their male and female flower distribution and leaf morphology. I have scrutinized the species known so far (Kuijt, 2000) and cannot match the present species with any known one. A similar but not quite identical distributional pattern of male and female inflorescences has been noted for another Venezuelan species, *D. cuneifolia*, which may be closely related but has a very different leaf shape and size, and nearly twice as many female flowers per fertile bract (Kuijt, 1990).

The specific epithet refers to the Cordillera de Mérida, where both known specimens were collected. The holotype is a unicate.

Paratype. VENEZUELA. **Mérida:** Sierra Nevada, near Alto del Aguada, 300–3500 m, *L. Bernardi et al. 17111* (LEA).

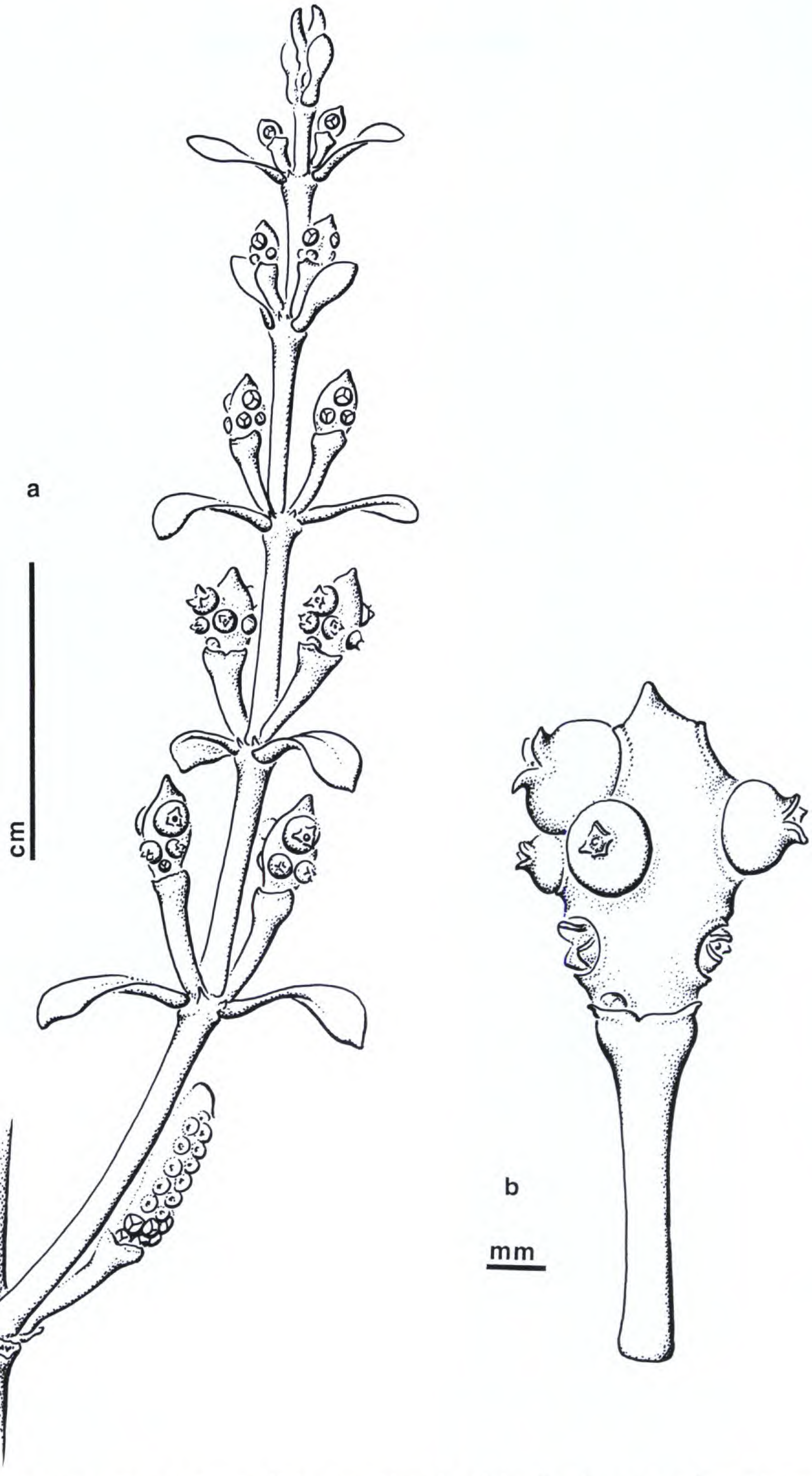

Figure 11. *Dendrophthora meridana* Kuijt. —a. Habit, lateral branch with female inflorescences flanked by two male inflorescences in prophyllar positions. —b. Young infructescence. Drawn from *Riina et al. 623* (VEN).

47. Dendrophthora warmingii (Eichler) Kuijt, comb. nov. Basionym: *Phoradendron warmingii* Eichler, in Warming, Vidensk. Meddel. Dansk. Naturhist. Foren. Kjoebenhavn. 209. 1870. TYPE: Brazil. Lagoa Santa, on *Vochysia elliptica*, 14 Jan. 1865, *E. Warming 383* (holotype, C).

Dendrophthora tepuiana (Steyermark) Kuijt, Proc. Kon. Ned. Akad. Wetensch. 93: 138–139. 1990. Venezuela. Bolívar: Ptari-tepuí, 1600 m, *Steyermark 59688* (holotype, F; isotype, US).

I have found, in the holotype of *Dendrophthora warmingii*, two instances of an apparently female flower with a small anther on one of the petals, as happens very occasionally in *Phoradendron* and *Dendrophthora*. These anthers, although underdeveloped, were almost certainly unilocular and, on the basis of this character, I feel confident about the assignment of this species to *Dendrophthora*. It should be noted that *Phoradendron rugulosum* Urban, which Rizzini (1991) recombined to *Phoradendron warmingii* Eichler var. *rugulosum* (Urban) Rizzini, is a synonym of *P. pteroneuron* Eichler (Kuijt, 2003).

Acknowledgment. The work here reported was done with financial support from the National Science and Engineering Research Council of Canada.

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Dischidia cleistantha (Apocynaceae, Asclepiadoideae): A New Philippine Endemic

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ABSTRACT. *Dischidia cleistantha*, a new species endemic to the Philippines, is described and illustrated. It is distinguished from three other species of *Dischidia* sect. *Conchophyllum* native to the Philippines by the character combination of corolla adaxially glabrous, 7–7.5 mm long, with corolline corona lobes opposite the corolla lobes, fleshy triangular dorsal staminal appendages, and unstalked staminal corona lobes.

Key words: Apocynaceae, Asclepiadaceae, Asclepiadoideae, *Conchophyllum*, *Dischidia*, Philippines.

Ongoing studies of the genus *Dischidia* R. Brown have revealed that a plant known in cultivation as *Dischidia* "Thailand Red" belongs to a new species endemic to the Philippines.

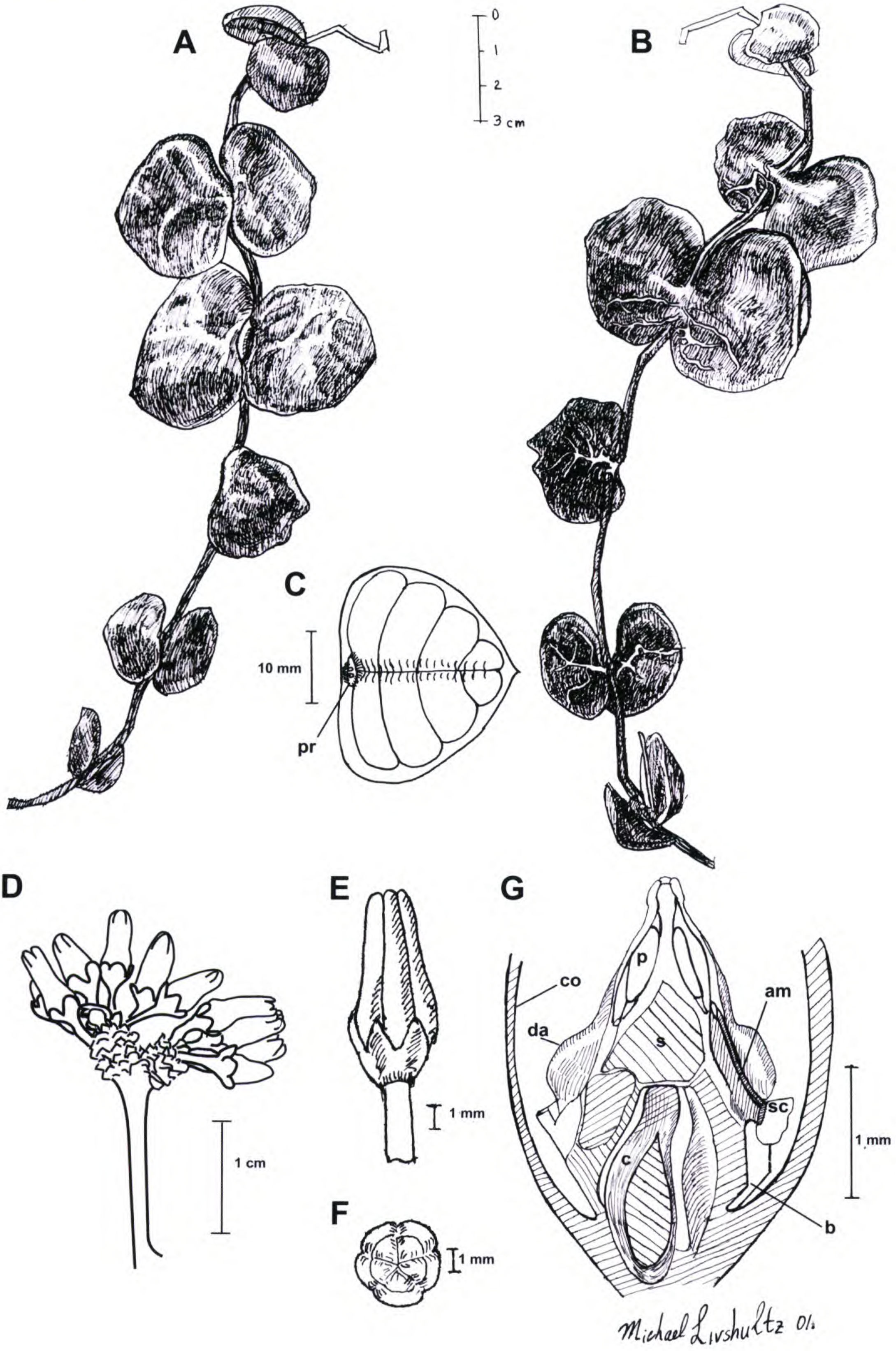
MATERIALS AND METHODS

Specimens were observed with light and scanning electron microscopy (SEM). For SEM, flowers that had been preserved in FAA and stored in 70% EtOH were put through a dehydration series and critical-point dried; anther margins and pollinaria were removed from fresh flowers (vouchered by *Livshultz 98–6*, BH) and air-dried. All specimens observed with SEM were mounted on aluminum stubs with two-sided tape and dissected. Stubs were coated with gold-palladium and viewed with a Zeiss 960 SEM. All photography is digital. Figure 2C was retouched to remove a small nick in the corolla tube, 2D to remove a charge line, and Figure 2E to remove cracks in the background; retouching did not alter the morphology or micromorphology depicted in the images. Distribution of sclerenchyma in the stamens was determined by staining spirit-preserved flowers with phloroglucinol-HCl.

Dischidia cleistantha Livshultz, sp. nov. TYPE: Philippines. Zamboanga Province: Mindanao, Sep. 1922, *E. D. Merrill 11639* (holotype, K; isotypes, P, US). Figures 1, 2, 3A, C–D.

Species foliis patelliformibus (convexo-concavis) instructa, a speciebus aliis omnibus distincta tubo corollae intus omnino glabro, lobis corollinis coronae lobis corollae oppositis, corona staminali ex lobis sessilibus ancoriformibus sub antheras insertis formata, appendicibus staminalibus dorsalibus ex lobis carnosis triangularibus constantibus.

Plants succulent, herbaceous epiphytic vines, root climbers and twiners, with white latex in all parts (Fig. 1A), glabrous except for sparse hairs near the margins of some younger leaves, lacking wax chimneys on stems and leaves (Fig. 3A). *Roots* on mature plants adventitious, always paired below each node, additional roots occasionally produced along internodes (Fig. 1B). *Stems* terete; diameter 1.5–3 mm; internodes 3.5–7.6 cm long. *Stipular colleters* a minute pair, triangular or ovate, to 0.5 mm long. *Leaves* always opposite, decussate at first, becoming distichous, peltate at maturity; petiole 1–3 × 1–2 mm; lamina with inflexed margins at first, at maturity the adaxial surface convex, green, the abaxial surface concave, purple (Fig. 1A, B), 1.3–3.6 × 1.6–5 cm, transverse-ovate to reniform, apex acute to obtuse, base truncate to slightly cordate, bearing a small protuberance with 1 to 3 colleters on the adaxial side (Fig. 1C); venation obscurely raised adaxially, invisible abaxially, brochidodromous, with 3–4 pairs of secondaries (Fig. 1C). *Inflorescence* (Fig. 1D) extra-axillary, umbelliform or compound-umbelliform, persistent; peduncles 0.4–2.0 × 0.15–0.2 cm, bearing 1–3(–4) stout rachises at their apices; rachises 3–4 mm diam., up to 1.4 cm long, with extremely short internodes, each rachis bearing 6 to 12 flowers and buds at its tip when actively growing; lower portions of rachises covered with transversely elliptical scars where flowers have fallen. Each *flower* subtended by two membranous triangular to lunate bracts ca. 0.5 × 0.5 mm; the bracts becoming chartaceous, persistent after flowers fall, but wearing off from the oldest parts of the rachises; *pedicels* 3–4 × 1 mm, pale green; *sepals* quincuncial, 1.5 × 1.5 mm, with a minute ovate colleter within each sinus, ovate, apex obtuse, pale green with hyaline margins, margins ciliate or not; *corolla* tube 7–7.5 × 3.5 mm, succulent, urceolate, 5-ribbed, the rounded, shallow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ribs separated by valleys opposite the corolla lobe sinuses (Fig. 1E, F); corolla lobes valvate, 2 × 1 mm, tips cucullate (Figs. 2A, 3C), connivent at anthesis, adaxial epidermal cells flattish tabular, ornamented with longitudinal striations (Fig. 2B) (terminology from Christensen & Hansen, 1998); *corolline corona* of 5 prominent lunate wedges inserted adaxially, 2.5 mm from the base of the corolla, opposite the lobes, inner surface of corolla tube rugose below the corolline corona (Fig. 2C); corolla at anthesis white suffused with purple, the pigment most prominent on the valleys and on the margins of the corolla lobes, pigment actually in the subepidermal cells of the adaxial corolla surface, on the margins and tips of the corolla lobes, the valleys between ridges (Fig. 3C), the corolline corona lobes and the tube below the corolline corona lobes, entire flower becoming pale pink with age. *Gynostegium* 2.5 × 2 mm, conic in outline, almost sessile, basal (filament) tube 0.2 mm long (Fig. 1G); *anthers* triangular, 2 × 1 mm; connectives dark purple with triangular, white, hyaline appendages covering the style-head apex; each anther margin with an inner and an outer edge (Fig. 2E); the outer edges form an open "mouth" at the base of the anther margins, revealing the inner edges (Fig. 2D); *staminal corona* of five unstalked lobes inserted at the bases of the anthers, each lobe with two recurved arms at its apex, white (Fig. 2D); *dorsal staminal appendages* of five fleshy, triangular lobes inserted on the abaxial surface of the anthers (Figs. 1G, 2D, 3C), each lobe suffused with pale purple pigment; *sclerenchyma* restricted to the anther margins, lateral margins of the dorsal staminal appendages, and the distal and outer edges of the arms of staminal corona lobes; *pollinarium* (Figs. 2F, 3D) with pollinia acropetal to the corpusculum when in situ, corpusculum narrowly elliptic, 230–240 × 60–80 μm, apex obtuse, rounded to truncate; caudicles flattened, with a thin region forming a channel along the outer edge (Fig. 2F), triangular with a long, narrow "thumb" extending from the apex of the outer edge, 300–330 (including thumb) × 70–90 μm; pollinium dorsiventrally flattened, narrow-obovate to elliptic, apex slightly truncate, 480–510 × 100–110 μm; *carpels* 1.2 × 0.4 mm diam., obclavate (Figs. 1G, 3C), *style-head* obturbinate, 5-angled in cross section with 5 reflexed lobes alternating with the stamens, 1.4 × 0.8 mm; apex acuminate, 0.8 × ca. 0.2 mm (Figs. 1G, 3C). *Fruit* a single follicle developing from each flower, pedicels 5–6 × ca. 1 mm, follicle 5.0–5.4 × 0.3–0.5 cm diam., reflexed relative to the pedicel, lanceolate in outline, widest 3.5 cm from the apex, gradually tapering toward both ends, apex obtuse, base rounded, cross section terete or half-terete (distorted by pressing), coriaceous and glabrous; *seeds* attached to a white, papery placenta, about 20 per fruit, 3 × 1 mm, ovoid, obscurely winged on the margin, testa smooth, glabrous; coma 2–2.5 cm long, white, silky.

Flowering specimens collected in January, February, August, September, November, and December from wild populations; continuously flowering under greenhouse conditions in Ithaca, New York.

Common names. The Tagalog name is reported as "pag-ong-pag-ongan" (*Fox 9073*). In cultivation, this species is called "*Dischidia* 'Thailand Red'" or "*D.* 'Thailand Blush'".

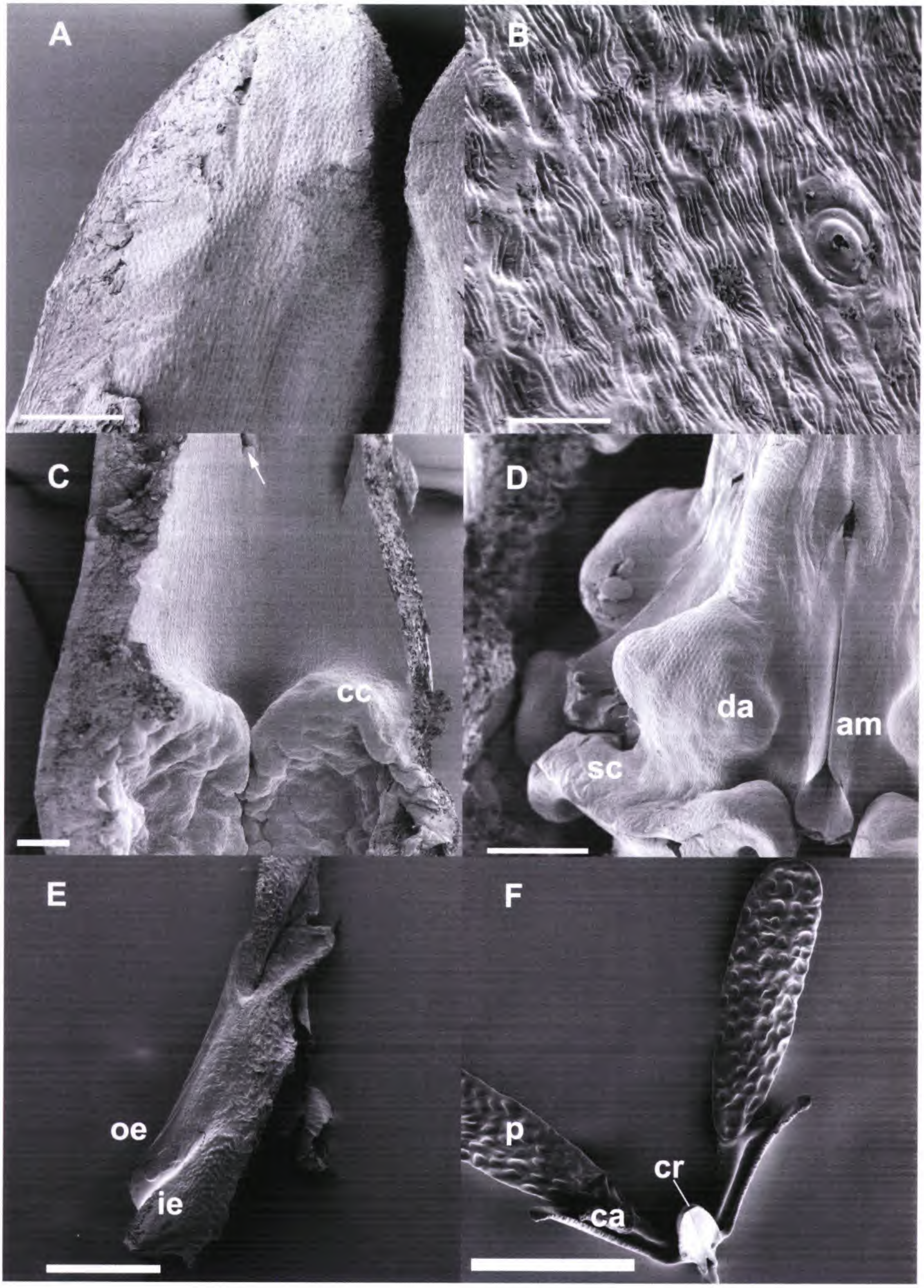
Etymology. The specific epithet is derived from the closed appearance at anthesis of flowers from living plants.

Discussion

Dischidia cleistantha is one of several previously undescribed shell-leaved species from the Philippines. Specimens of *D. cleistantha* have been identified as *D. purpurea* Merrill, *D. platyphylla* Schlechter, and *D. imbricata* (Blume) Steudel on herbarium labels. *Merrill 8319* was listed among the exsiccatae of *D. platyphylla* in the *Enumeration of Philippine Flowering Plants* (Merrill, 1923). The first two of these species are endemic to the Philippines (Merrill, 1923), whereas *D. imbricata* is widespread in Malesia (Rintz, 1980) but collected only from Palawan in the Philippines (Livshultz, pers. obs.). Table 1 lists characters that can be used to distinguish them. The glabrous flowers of *D. cleistantha* easily distinguish it from *D. platyphylla* and *D. imbricata*, which have dense hairs on the bases (*D. platyphylla*) or tips and margins (*D. imbricata*) of the adaxial side of the corolla lobes. *Dischidia cleistantha* has much larger flowers than *D.*

←

Figure 1. *Dischidia cleistantha* Livshultz. —A. Branch, dorsal surface. —B. Branch, ventral surface. —C. Schematic drawing of adaxial leaf surface, showing protuberance with colleters and venation. *pr* = protuberance. —D. Inflorescence. —E. Longitudinal view of flower. —F. Apical view of flower. —G. Schematic drawing of longitudinal section of gynostegium in Figure 3C. Diagonal cross-hatching indicates cut surface. *co* = corolla; *da* = dorsal staminal appendage; *p* = pollinium; *s* = style-head; *am* = anther margin; *sc* = staminal corona; *c* = carpel; *b* = basal (filament) tube. Drawn from *Livshultz 98–6*.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purpurea (7 mm long vs. 2 mm long) and usually shorter peduncles (mostly less than 2 cm vs. mostly 7 cm or more).

Dischidia cleistantha and *D. purpurea* share several unusual characters that suggest a close phylogenetic relationship between the two species. Both species have 5-ribbed corollas with inflexed lobes at anthesis; the corolla lobes of *D. purpurea* separate slightly along their margins and the ribs are alternate with rather than opposite the corolla lobes. Both deposit purple pigment in the subepidermal layer of the adaxial side of the corolla while the abaxial cell layers remain unpigmented. Both have corolline corona lobes opposite the corolla lobes, although *D. purpurea* also has inconspicuous pouches in the sinuses of the corolla lobes. *Dischidia purpurea* has two distinct flower forms. One form has dorsal staminal appendages similar to those of *D. cleistantha* but no staminal corona. The other form has no dorsal staminal appendages but does have a staminal corona of unstalked lobes very similar to those of *D. cleistantha* except that the arms point up rather than down. It is still uncertain how these floral forms of *Dischidia purpurea* should be recognized taxonomically since they are otherwise identical. The unstalked staminal corona lobes of *D. cleistantha* and *D. purpurea* are unusual but evidently homologous to staminal corona lobes in other *Dischidia* species. The dorsal staminal appendages found in *D. cleistantha* and *D. purpurea* are much more restricted taxonomically, occurring also in *D. astephana* King & Gamble and *D. cochleata* Blume. It is convenient to communicate the homology of stamen ornaments among *Dischidia* species by distinguishing "dorsal staminal appendages" from "staminal coronas" even though "staminal corona" is the general term for any ornament of the stamens in Apocynaceae (Liede & Kunze, 1993).

Corolline corona lobes are typically alternate with the petals both in *Dischidia* and in the Apocynaceae as a whole (Liede & Kunze, 1993; Endress & Bruyns, 2000). In *Dischidia* species with annular corolline coronas, the annulus is enlarged opposite the corolla lobe sinuses, e.g., *D. astephana* King & Gamble (illustrated in Rintz, 1980). The presence of lobes both opposite and alternate to the corolla lobes in *D. purpurea* suggests that the opposite and alternate lobes are not homologous.

Dischidia cleistantha has the typical shell-shaped leaves of *Dischidia* sect. *Conchophyllum* K. Schumann. Species in this section can easily be distinguished by using floral characters, but the minute dimensions of the flowers and their frequent absence from specimens can make species in this group difficult to identify. This may explain why *D. cleistantha* has remained undetected for so long both in herbaria and in cultivation. Vegetatively, *D. cleistantha* differs from most other species of the section in the absence of wax chimneys, donut-shaped white collars around the stomata (compare Fig. 3A to 3B) (see also SEM micrographs in Huxley, 1980; Theisen & Barthlott, 1994). In other species of section *Conchophyllum*, wax chimneys are most prominent on the abaxial surfaces of leaves, but they are present on both leaf surfaces as well as stems and peduncles. To the naked eye they appear as small white dots or a pruinose surface, depending on their density. The chimneys can be seen easily with a hand lens. Chimneys may be obliterated on older leaves by continued wax deposition; their occasional absence from herbarium specimens of species that typically have them is likely an artifact of preservation, either due to exfoliation of the epicuticular wax or coating of the specimen with glue. While leaves of herbarium specimens of *D. cleistantha* can look pruinose due to flaking off of the epicuticular wax, careful examination with a dissecting microscope shows that they lack chimneys. Presence or absence of wax chimneys is potentially a phylogenetically informative character in *Dischidia*. In section *Conchophyllum*, most species have wax chimneys except for *D. cleistantha* and some accessions of *D. purpurea* and *D. imbricata*. There is a cultivated accession of *D. imbricata* that lacks wax chimneys (vouchered by *Livshultz 99–7*, BH), so the polymorphism in this species is not due to artifacts of preservation. Wax chimneys are sporadic outside section *Conchophyllum*, occurring in *D. major* (Vahl) Merrill, *D. nummularia* R. Brown, *D. antennifera* Beccari, *D. bengalensis* Colebrooke, and *D. kutcinensis* Beccari.

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Figure 2. Floral morphology of *Dischidia cleistantha*.—A. Cucullate corolla lobes. —B. Adaxial surface of corolla lobe, flattish tabular epidermal cells with longitudinal striations. —C. Adaxial surface of corolla tube. *cc* = corolline corona lobe. The *arrow* points to a corolla lobe sinus. —D. Gynostegium. *sc* = staminal corona lobe; *da* = dorsal staminal appendage; *am* = anther margin. —E. Anther margin broken off and turned so that the inner edge is up. *ie* = inner edge; *oe* = outer edge. —F. Pollinarium. Corpusculum rotated relative to caudicles and greatly foreshortened. *cr* = corpusculum; *ca* = caudicle; *p* = pollinium. All scale bars = 200 μm except for B, scale bar = 20 μm. From *Livshultz 98–6*.

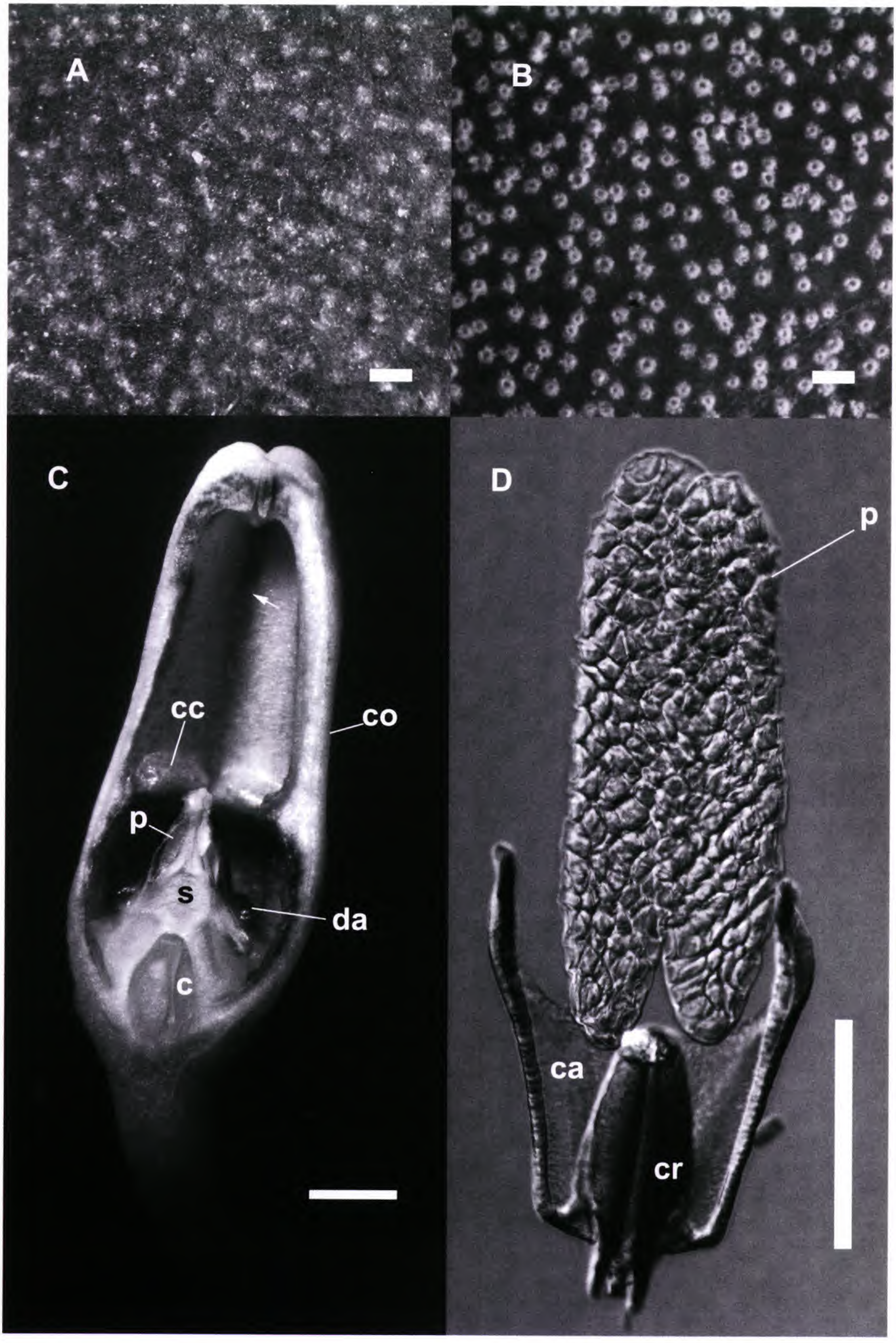
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Table 1. Characteristics distinguishing *Dischidia cleistantha* from three other shell-leaved species native to the Philippines.

	D. cleistantha Livshultz	*D. purpurea* Merrill	*D. platyphylla* Schlechter	*D. imbricata* (Blume) Steudel
Wax chimneys	absent	present (absent)	present	present (absent)
Peduncle length (cm)	0.4–2.0	(0–6)7–22 usually at least one over 7 cm	1.5–6.0	1–5.5
Corolla tube length × width (mm) (fresh or reconstituted)	7–7.5 × 3.5	1.8–2.5 × 1.4–1.9	3–4 × 3–4.5	3–5 × 2.5–4.5
Corolla tube color	white suffused with purple, purple pigment localized on the adaxial surface, pink with age	pale purple, purple pigment localized on the adaxial surface, pink with age	pale yellow/cream, margins of corolla lobes pink	pale yellow/cream, corolla lobes sometimes tinged with pink
Hairs inside corolla tube	glabrous	glabrous or margins of corolla lobes sparse ciliate	dense tufts of long hairs at bases of corolla lobes	tips and margins of corolla lobes with long, dense retrorse hairs
Corolline corona	lobes opposite corolla lobes, inserted well below level of corolla lobe sinuses	minute pouches inserted in corolla lobe sinuses; vertical ridges opposite corolla lobes, extending from level of corolla lobe sinuses to base of corolla tube	lobes alternate with corolla lobes, inserted just below corolla lobe sinuses	lobes alternate with corolla lobes, inserted just below corolla lobe sinuses
Staminal corona lobes	present, unstalked, arms recurved, pointing down	present or absent; when present unstalked, arms pointing up*	present, stalked, held perpendicular or parallel to anther, arms recurved	much reduced, consisting of 2 small bumps below the anther, appearing to be absent
Dorsal staminal appendages	present, fleshy triangular lobe; in reconstituted specimens, appearing as two fleshy elliptic lobes inserted longitudinally	present or absent; when present a fleshy triangular lobe. In reconstituted specimens, appearing as two fleshy elliptic lobes inserted longitudinally*	absent	absent

* Individual specimens of *D. purpurea* have either a staminal corona or dorsal staminal appendages, never both. This character is consistent within specimens.

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Figure 3.—A. Abaxial leaf surface of *Dischidia cleistantha*; no wax chimneys. The small white bumps are stomata. —B. Abaxial leaf surface of *Dischidia platyphylla* Schlechter with wax chimneys. —C. Longitudinal section through flower of *Dischidia cleistantha* showing distribution of pigment in the corolla tube (*arrow*), the relative position of the corolline corona (*cc*) and the gynostegium, and a section through the gynoecium. Diagram of gynostegium shown in Figure 1G. *co* = corolla. The *arrow* points to pigment in the valley between two ridges; the valley is opposite the corolla lobe sinus. *cc* = corolline corona; *da* = dorsal staminal appendage; *s* = style-head; *c* = carpel. —D. Pollinarium of *Dischidia cleistantha*, in situ orientation. *p* = pollinium; *ca* = caudicle; *cr* = corpusculum. A, B, D scale bar = 200 μm, C scale bar = 1 mm. A, C, D from *Livshultz 98–6*; B from *Livshultz 02–52* (BH).

Because of their succulence and complex floral structure, specimens of *D. cleistantha* are greatly distorted by pressing and drying. The papillae apparent along the leaf veins of herbarium specimens are an artifact of drying; there is no evidence of them on fresh leaves. They are not homologous to the papillae that blanket the epidermis in some other *Dischidia* species, e.g., *Dischidia hirsuta* (Blume) Decaisne. The corolla lobes of pressed flowers usually separate, and the ribs on the corolla tube are obscured. The corolline corona may appear as a continuous ring rather than distinct lobes. The "mouth" formed by the anther margins may be destroyed by separation of the margins. The staminal corona collapses when dried and may not be detectable without careful probing to separate the arms from the stamen. The central part of the dorsal staminal appendage collapses and the lobe appears as two longitudinal ridges. Fruits are described from an herbarium specimen, *Ramos & Edano 75232*; the orientation and shape of uncompressed fruits may differ.

Dischidia cleistantha is endemic to the Philippines. Its presence on the northern island of Luzon and the southern island of Jolo suggests a distribution throughout the archipelago. The available collection information indicates a lowland and coastal species. It has been collected from trees on the sea coast (*Fox 9073*), in a mangrove swamp (*Barbon et al. 2089*), and on a river bank (*Ramos & Edano 75232*).

Paratypes. PHILIPPINES. **Benguet:** Luzon, Kapungun, Tublay, *M. S. Clemens 17233* pro parte (NY). **Quezon:** Polillo, Karlangan, *R. B. Fox 9073* (A); Luzon, Burdeos, Botanan, *Barbon et al. 2089* (BRIT). **Catanduanes:** Catanduanes, St. Domingo River, *Ramos & Edano 75232* (NY). **Zamboanga:** Mindanao, *H. Hallier 650* (NY); Mindanao, *H. Hallier 4650* (L); Mindanao, *E. D. Merrill 8319* (K, L, P, NY). **Basilan:** Basilan, Malamam, Mt. Basilan, *Moseley s.n.* (K). **Sulu:** Jolo, *Ramos & Edano 44404* pro parte (US, NY). CULTIVATED, PROVENANCE UNKNOWN. *T. Livshultz 98–6* (BH).

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Solanum pseudodaphnopsis (Solanaceae), a New Species from the Critically Endangered Restinga Vegetation in Southern Brazil

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ABSTRACT. We describe and illustrate a new species of *Solanum* (Solanaceae) from southern Brazil. *Solanum pseudodaphnopsis* belongs to *Solanum* sect. *Geminata* and grows in the restinga, a special sandy coastal vegetation complex, in Paraná and Santa Catarina states. It resembles morphologically *S. cassioides* L. B. Smith & Downs and *S. arenarium* Sendtner, but it can be distinguished from the former by the presence of obovate and leathery leaves and from the latter by its dendritic-echinoid trichomes and narrower leaves.

RESUMO. Nós descrevemos e ilustramos uma nova espécie de *Solanum* (Solanaceae) do sul do Brasil. *Solanum pseudodaphnopsis* pertence a *Solanum* sect. *Geminata* e cresce nos solos arenosos da região costeira do Paraná e Santa Catarina. Assemelha-se morfologicamente a *Solanum cassioides* L. B. Smith & Downs e a *S. arenarium* Sendtner, podendo ser distinta da primeira espécie pelas folhas obovadas e coriáceas e da segunda pelos tricomas dendrítico-equinóides e folhas mais estreitas.

Key words: Brazil, Solanaceae, *Solanum*.

The genus *Solanum* L. (Solanaceae) comprises about 2000 species, and the taxonomy of the group remains poorly known. The Neotropical region is the richest in *Solanum*, with an estimate of about 850 species (Nee, 1999). Taxonomic treatments of several *Solanum* groups including species from the Brazilian flora have been published by Correll (1962), Roe (1972), Edmonds (1972), Bohs (1994, 1995, 2001), Whalen et al. (1981), and Nee (1991a, 1991b). Although no checklist of the Brazilian flora has been published yet, we anticipate about 320 species, most of these growing in the southeastern and southern regions. A recent revision mentioned 87 species in southern Brazil (Mentz, 1998).

During our revision of *Solanum* in southern Brazil, we found an undescribed species belonging to *Solanum* sect. *Geminata*. This section is recognized by its geminate and commonly unequal leaves, glabrous or with simple or dendritic trichomes, and by the inflorescence opposite the leaves. *Solanum* sect. *Geminata* was revised by Knapp (1986, 1991, 2002). The new species described herein adds to our knowledge of the section.

Solanum pseudodaphnopsis L. A. Mentz & Stehmann, sp. nov. TYPE: Brazil. Paraná: Paranaguá, Matinhos, 20 Sep. 1946 (fl, fr), *G. Hatschbach 382* (holotype, MBM; isotypes, B, PACA, W). Figure 1.

Species *S. cassioide* et *S. arenario* proxima; a primo foliis obovatis coriaceisque et altero foliis angustioribus et trichomatibus dendriticis-echinoidibus recedit.

Shrubs to 1.7 m high. Branches woody, cylindrical, dark green to almost dark brown, glabrate, apical branches light, tinged in green or gold, covered with dendritic-echinoid trichomes. Leaves solitary, rarely paired, if so then unequal. Petiole 0.3–0.5 cm, with dendritic-echinoid trichomes. Blade coriaceous, shiny, drying olive-green to cinereous, obovate, attenuate at base, obtuse, rounded or slightly acute at apex, margin slightly revolute in dry material, 5–12.5 × 1.5–5.5 cm, adaxial surface glabrous or with a few dendritic-echinoid trichomes on the nerves (young leaves), abaxial surface with evident yellow veins, young leaves presenting sparse dendritic-echinoid trichomes, old leaves entirely glabrous or with a few dendritic-echinoid trichomes at midrib. Inflorescence monochasial cyme, unbranched, rarely branched, opposite the leaves,

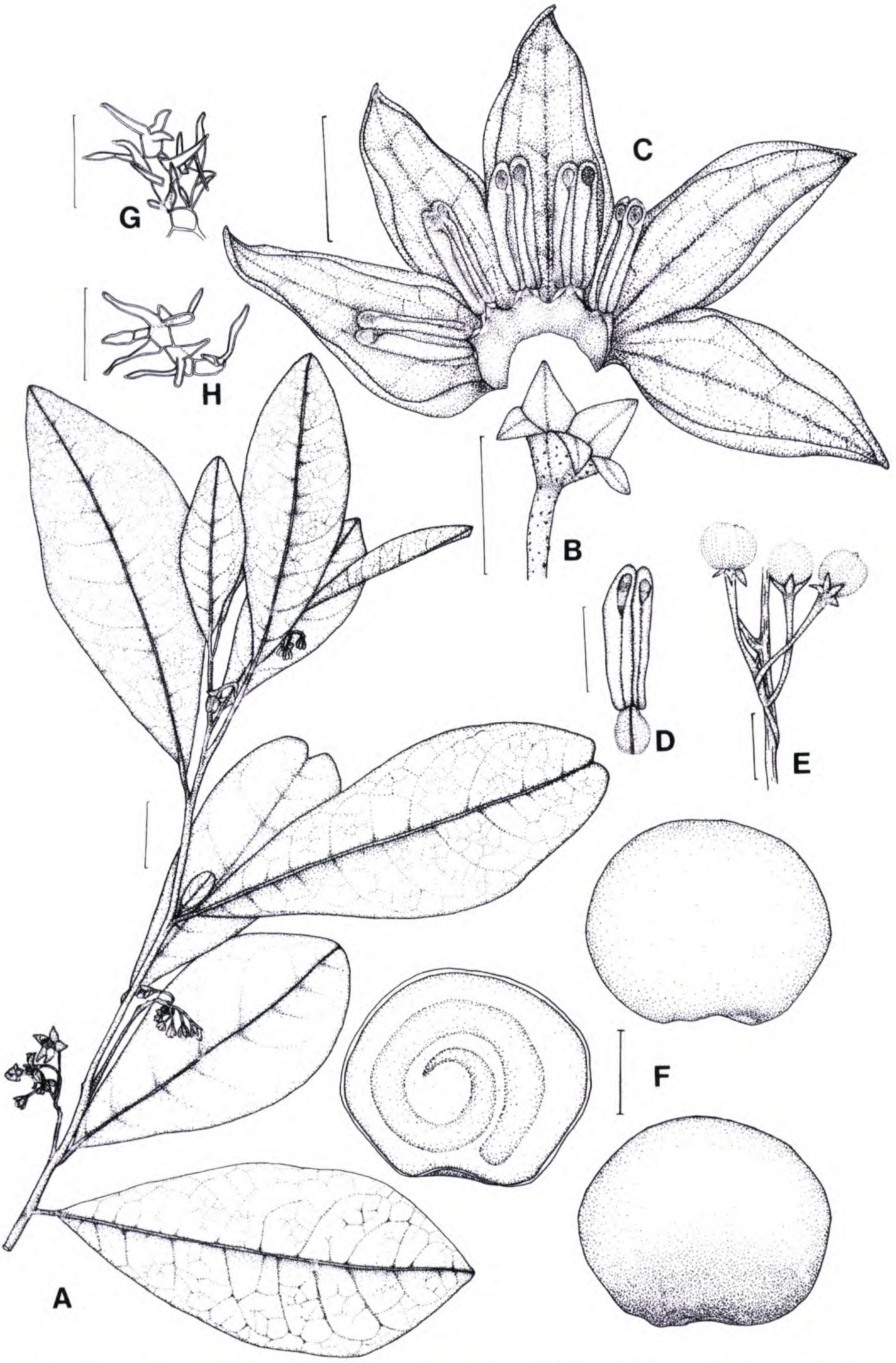

Figure 1. *Solanum pseudodaphnopsis* L. A. Mentz & Stehmann. —A. Habit. —B. Calyx. —C. Corolla. —D. Stamen. —E. Fruit. —F. Seed from both sides and by longitudinal section. —G, H. Dendritic-echinoid trichomes. (A–D, G, H from *Falkenberg & Da-Ré 5416*; E, F from the holotype *Hatschbach 382*). Scale bars A = 2 cm; B, C = 5 mm; D = 2 mm; E = 1 cm; F = 1 mm; G, H = 100 μm.

occasionally lateral, 12(to 19)-flowered, flowers arranged on one side only. *Peduncles* to 2.5 cm long, pedicels to 2 cm long, both covered with sparse dendritic-echinoid trichomes; buds elliptic. *Calyx* externally glabrous to scarcely pubescent, internally dendritic-echinoid, ca. 4 mm long, lobes ca. 2 mm long, ovate. *Corolla* rotate, white, externally glabrous, internally glabrescent or with scarce dendritic-echinoid trichomes, deeply 3/4 partite, lobes reflexed after anthesis. *Stamens* 5, anthers oblong, yellow, 2–3 mm long, dehiscence introrse-lateral, splitting to 1/3 of its length, filaments connate at base forming a ring ca. 0.5 mm high. *Ovary* globose, glabrous, style to 7 mm long, exserted beyond anthers, stigma thickened. *Fruit* a berry, globose, glabrous, to 1 cm diam., pedicels to 2.5 cm, distally dilated, ca. 2.5 mm diam., proximally ca. 1 mm diam. near the base. *Seeds* ellipsoid-reniform, about 3 mm long.

Local names. Brazil: "canema-mirim, caneminha, canema-do-brejo" (*Hatschbach 382*).

Geographic distribution. *Solanum pseudodaphnopsis* is restricted to the coastal sandy habitats of restinga vegetation in Santa Catarina and Paraná, southern Brazil. It grows in open places, gaps, or borders of coastal rain or swamp forest.

Phenology. Flowering specimens have been collected from August to November; fruiting specimens have been collected from September to November.

Etymology. The specific epithet is a reference to the shape of the leaves resembling those of species of *Daphnopsis* (Thymelaeaceae), which has obovate and leathery leaves and grows in southern Brazil.

Solanum pseudodaphnopsis is recognized by its obovate, glabrous or very sparsely pubescent and leathery leaves, and a pubescence of dendritic-echinoid trichomes. It most closely resembles *S. cassioides* and *S. arenarium*. *Solanum cassioides* differs morphologically by its obovate-lanceolate, to lanceolate or elliptic and membranaceous leaves, glabrous or also with dendritic-echinate trichomes, and by its corymbiform-fasciculate inflorescence. *Solanum arenarium* differs morphologically by its larger and broader leaves and by its dendritic trichomes. These trichomes never have an echinate form. The dendritic trichomes of *S. cassioides* and *S. pseudodaphnopsis* usually show delicate and delicate-curved branches, whereas *S. arenarium* has typically dendritic hairs with branches along the stalk. An illustration of these trichomes was presented by Mentz et al. (2000). The habitat of these species is also different. While *Solanum cassioides* grows in highlands, over 900 m a.s.l., *S. arenarium* grows in forest spots, mainly on granitic hills, up to 300 m a.s.l., and *S. pseudodaphnopsis* grows in the restinga vegetation, near sea level.

Solanum pseudodaphnopsis belongs to *Solanum* sect. *Geminata* sensu Knapp (1986). This section (with different circumscription) was included in *Solanum* sect. *Holophylla* (G. Don) Walpers and treated as a subsectional level by Nee (1999). Because of its ellipsoid-reniform seeds, *S. pseudodaphnopsis* must be included in the *S. arenarium* group. This group has four other species, but only *S. gnaphalocarpon* Vellozo and *S. arenarium* grow in Brazil (Knapp, 2002).

The restinga is characterized as an edaphic vegetational complex that occupies a narrow belt along the Brazilian coast (Rizzini, 1979; Veloso et al., 1991). This taxon was considered (as an ined. name) endangered, rare, or endemic in the shrubby restinga from Santa Catarina state (Falkenberg, 1999). There are other endemic species of Solanaceae growing in the Brazilian restinga. Knapp (1989) described *Solanum restingae* S. Knapp, an endemic species from the coastal vegetation of Bahia, in northeastern Brazil. Barbará and Carvalho (1996) reported the occurrence of 52 species of Solanaceae in the restinga from Rio de Janeiro state, 7 of them considered characteristic of this vegetation: *Brunfelsia latifolia* (Pohl) Bentham, *Cestrum intermedium* Sendtner, *Cyphomandra sycocarpa* (Martius & Sendtner) Sendtner, *Solanum aciculare* Swartz ex Sendtner, *S. curvispinum* Dunal, *S. nemorense* Dunal, and *S. subscandens* Vellozo. Within southern Brazil, at least 5 species of Solanaceae are endemic in the restinga complex: *Calibrachoa heterophylla* (Sendtner) Wijsman, *Petunia littoralis* L. B. Smith & Downs (probably an ecotype of *P. integrifolia* (Hooker) Schinz & Thellung), *Solanum flagellare* Sendtner, *S. pelagicum* Bohs, and *S. reineckii* Briquet (Smith & Downs, 1966; Falkenberg, 1999; Stehmann, 1999; Bohs, 2001). Because of the occurrence of these endemic species from Solanaceae and other groups of plants, as well as the vanishing of the restinga vegetation (Falkenberg, 1999), efforts to preserve undisturbed restinga areas are fundamental to preserving its biodiversity.

Paratypes. BRAZIL. **Paraná:** Guaratuba, Rio da Praia, 12 Aug. 1963, *G. Hatschbach 10198* (MBM); Paranaguá, Shangri-lá, 22 Sep. 1995, *J. Cordeiro 1241 & E. Barbosa* (MBM); Barranco, 23 Oct. 1968, *G. Hatschbach 20109* (MBM); Rio da Vila, 2 Sep. 1980, *G. Hatschbach 43175* (MBM); Praia do Leste, 3 Oct. 1966, *J. C. Lindeman & H. Haas 2636* (HBR, MBM); Ilha do Mel, Praia Grande, 28 Mar. 1988, *S. M. Silva 1501 & M. R. P. Leite* (BHCB, UPCB). **Santa Catarina:** Itapoá, Fazenda Palmital, propriedade de Lúcio Machado, 2 Nov. 1990, *D.*

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Two New Species of *Calceolaria* (Scrophulariaceae) from the Tropical Andes

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ABSTRACT. Two new species of *Calceolaria* L. (Scrophulariaceae) from the tropical Andes are described: *Calceolaria rhombifolia* Molau from northern Peru and *C. urticifolia* Molau from northern Bolivia, belonging to the sections *Rotundifoliae* and *Urticopsis*, respectively, within subgenus *Calceolaria*. This paper is the first addendum to the 1988 monograph in *Flora Neotropica*.

RESUMEN. Se describen dos nuevas especies de *Calceolaria* L. (Scrophulariaceae) de los Andes tropicales: *Calceolaria rhombifolia* Molau del norte de Perú y *C. urticifolia* Molau del norte de Bolivia. Pertenecen a las secciones *Rotundifoliae* y *Urticopsis*, respectivamente, dentro del subgénero *Calceolaria*. Este artículo es la primera adenda a la monografía de *Flora Neotropica* de 1988.

Key words: Bolivia, *Calceolaria*, Peru, Scrophulariaceae.

Calceolaria L. (Scrophulariaceae) is a Latin American genus of approximately 250 species ranging from Mexico to Tierra del Fuego. In the most recent monograph of the Neotropical representatives of the genus (Molau, 1988), 183 species were recognized in the Neotropical part of its distribution area. With the present circumscription, the genus comprises 3 subgenera and 22 sections (Molau, 1988). Nearly all of the Neotropical species belong to the subgenus *Calceolaria*, whereas the vast majority of the southern temperate species belong to the subgenera *Cheiloncos* and *Rosula*.

Since the 1988 monograph, a lot of new *Calceolaria* collections from the Neotropics have accumulated. However, most of these are from previously relatively well-known parts of the Andes, and only little among the accessions has so far called for an update of the monograph. There are huge "white spots" in the tropical Andes still awaiting primary botanical exploration, and it is symptomatic that only the collections of field parties working in remote and poorly explored areas have brought in *Calceolaria* collections that add to our knowledge of the genus. Most important of these are the groups of Isidoro Sánchez Vega and collaborators (Cajamarca) and Abundio Sagástegui A. et al. (Trujillo) operating in northern Peru, and Stephan Beck et al. (La Paz) undertaking fieldwork in northern Bolivia. In addition, the fieldwork of the late David N. Smith from many remote parts of the Peruvian Andes has yielded an important set of *Calceolaria* specimens, in some cases the first modern collections of species that were previously known only from the type collection. The collecting activity of the above-mentioned parties has provided material that now calls for taxonomic recognition. The two species described here are the first addendum to the 1988 monograph; both belong to subgenus *Calceolaria*.

Calceolaria rhombifolia Molau, sp. nov. TYPE: Peru. Cajamarca: Chota, El Agua Fría along the road from Chota to La Paccha, remnants of primary mountain scrub, 2400 m, 20 July 1993, *J. Cabanillas Soriano 734* (holotype, F). Figure 1A–C.

Suffrutex 0.5–1 m altus; caule distaliter puberula. Folia decussata; petiolo puberulo, 7–10 mm longo; lamina ovata vel rhombica, 2.3–6.7 × 1.3–3.8 cm, acuta, basi cuneata, margine grosse serrato. Inflorescentia puberula, terminalis, ex cymis 18- ad 50-floris una vel duabus constans; pedunculo primario 3.0–6.7 cm longo; pedicellis 1.0–1.4 cm longis; bracteis carentibus. Flos sepalis viridibus, triangularibus, 2.5–3.0 × 1.8–2.5 mm sub anthesi, acutis vel subacutis, puberulis, margine integro, corolla vivide flava, immaculata, labio inferiore 8–12 × 6–9 mm, parte saccata distaliter recurvata, elaeophoro munita; antheris bubalinis, 1.4–1.8 mm longis, omnino dehiscentibus, thecis ± aequalibus, divaricatis; stylo arcuato, 1.5–2.0 mm longo. Capsula conica, leviter acuminata, 4–6 mm longa, glanduloso-puberula.

Subshrub, 0.5–1 m tall; inflorescence and distal parts of stems puberulous. Leaves decussate, petiolate; blades ovate to almost rhombic, 2.3–6.7 × 1.3–3.8 cm, acute, cuneate at base, the margins coarsely serrate; upper surface deep green, puberulous; lower surface pale green, reticulate-venose, glabrous or puberulous; petioles puberulous, 7–10 mm long. Inflorescence distal, composed of 1 or 2 pairs of 18- to 50-flowered cymes, the primary pe-

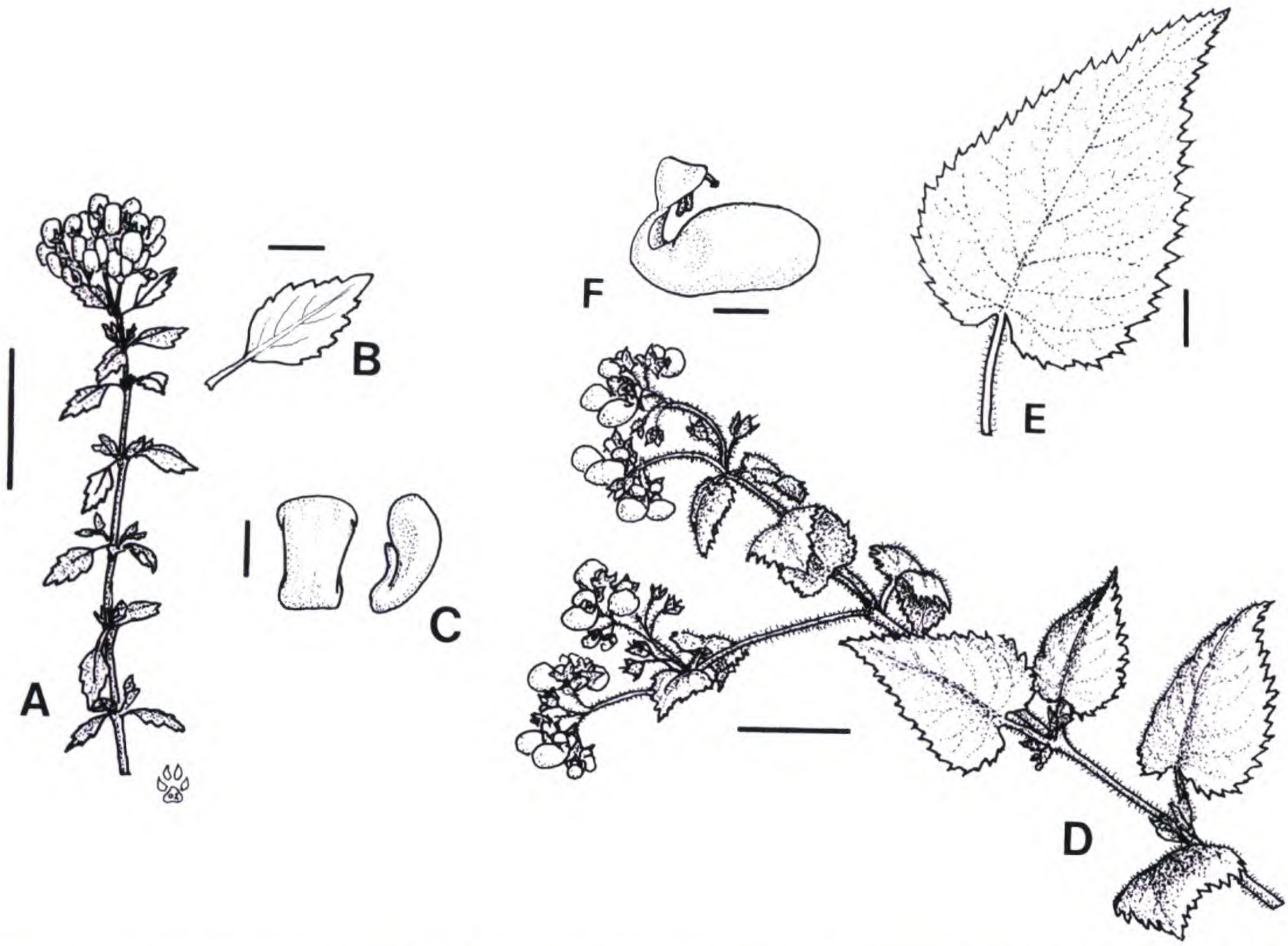

Figure 1. A–C. *Calceolaria rhombifolia* Molau (*Sagástegui et al. 8212*). —A. Flowering shoot. —B. Leaf. —C. Corolla (ventral and lateral view). D–F. *Calceolaria urticifolia* Molau (*Salinas 3276*). —D. Flowering shoot. —E. Leaf. —F. Corolla. Scale bars: A, D = 5 cm; B, E = 1 cm; C, F = 5 mm. Drawn by the author from herbarium material.

duncles 3.0–6.7 cm; pedicels 1.0–1.4 cm; cyme bracts absent. Sepals green, entire, triangular, 2.5–3.0 × 1.8–2.5 mm at anthesis, acute or subacute, puberulous. Corolla bright yellow, unspotted, minutely puberulous; upper lip arched, 2–3 × 4–5 mm; lower lip strongly upcurved, saccate in 50–60% of length, the upcurved portion 8–12 × 6–9 mm; eliophore present. Stamens buff; anthers dehiscing throughout, 1.4–1.8 mm, the thecae divaricate; filaments ca. 1.0 mm. Style arcuate, 1.5–2.0 mm. Capsule conical, slightly acuminate, 4–6 mm long, glandular-puberulous.

Distribution and habitat. Endemic to a small area in northern Peru, within or just south of the Huancabamba Deflection (cf. Molau, 1988), known from the southern part of Dept. Piura and adjacent parts of northern Cajamarca; mountain scrub, the altitudinal records ranging from 2300 to 2400 m. The paratypes cited below were collected within the lower portion of the Andes known as the Huancabamba Deflection, but on hills south of the division line following the bottom of the valley across the cordillera.

Leaf morphology and indumentum indicate that *Calceolaria rhombifolia* belongs to *Calceolaria* sect. *Rotundifoliae* (Molau, 1988), which now encompasses three species, all in northern Peru. It is most closely related to *C. rotundifolia* HBK, restricted to a small area north of the Huancabamba Deflection. The presence of this new taxon was anticipated in the monograph (Molau, 1988) because of some aberrant specimens from south of the Divide, even though the material did not suffice for taxonomic recognition at that time. The addition of the informative and well-preserved collection now selected as the type for *C. rhombifolia* completed the picture.

Calceolaria rhombifolia is easily distinguished from its northern sister species *C. rotundifolia* by the shape of the leaf blades (whence names). In addition, the leaf blades of *C. rhombifolia* are much larger than in *C. rotundifolia* (with leaves 0.9–1.7 cm long), they are cuneate at base (not cordate), and the margins are distinctly coarse-serrate, not lobate as in *C. rotundifolia*.

Paratypes. PERU. **Piura:** Huancabamba, summit be-

tween Schucumayo (= Shumayo) and Tabaconas, SE of Sondor, Nov. 1868, *A. Raimondi 639* (USM); Cerro La Viuda, Sondor district, 2300 m, 21 July 1975, *A. Sagástegui et al. 8212* (GB, HUT, MO).

Calceolaria urticifolia Molau, sp. nov. TYPE: Bolivia. La Paz: Inquisivi, 9 km from Choquetanga, canyon of the Río Calachaca–Jahura, 16°48'S, 67°19'W, 3400 m, remnants of mountain scrub in pastured landscape, 3400 m, 20 July 1994, *N. Salinas 3276* (holotype, GB; isotype, LPB). Figure 1D–F.

Suffrutex laxus, caule usque ad 2 m longo, distaliter glanduloso-villoso trichomatibus brunneolis. Folia decussata; petiolo dense glanduloso-villoso, 1.6–3.7 cm longo; lamina herbacea, ovata vel cordiformi, 5.5–10 × 4.8–7.4 cm, acuminata, basi cordata, margine acute serrato vel biserrato, supra olivacea, glanduloso-villosa, infra pallide olivacea, reticulato-venosa, pilosa. Inflorescentia puberula, terminalis, ex cymis 10- ad 26-floris una vel duabus constans; pedunculo primario 4.5–9.2 cm longo; pedicellis 1.3–2.2 cm longis; bracteis carentibus. Flos sepalis viridibus, ovatis, 5.0–6.0 × 3.2–4.0 mm sub anthesi, acutis vel leviter acuminatis, extra glanduloso-villosis, intra glabris, margine integro; corolla vivide flava, probabiliter immaculata, labio superiore 3–5 × 5–7 mm, inferiore procurrente, 14–17 × 11–15 mm, elaeophoro munita; antheris fulvis, 2.3–3.0 mm, omnino dehiscentibus; thecis ± aequalibus, divaricatis; stylo 1.9–2.5 mm longo. Capsula ovoidea, 5–7 mm longa, breviter glanduloso-hirsuta; seminibus ca. 0.3 mm longis.

Lax subshrub, the stems up to 2 m long; inflorescence and distal parts of stems glandular-villous with brown-tinged hairs. Leaves decussate, petiolate; blades herbaceous, ovate to cordiform, 5.5–10 × 4.8–7.4 cm, acuminate, cordate at base, the margins sharply serrate or biserrate; upper surface olive green, glandular-villous (becoming glandular-pilose with age); lower surface pale green, reticulate-venose, pilose; petioles densely glandular-villous, 1.6–3.7 cm long. Inflorescence distal, composed of 1 or 2 pairs of 10- to 26-flowered cymes, the primary peduncles 4.5–9.2 cm; pedicels 1.3–2.2 cm; cyme bracts present. Sepals green, ovate, entire, 5.0–6.0 × 3.2–4.0 mm at anthesis, acute or slightly acuminate, externally glandular villous, internally glabrous. Corolla bright yellow, probably unspotted, minutely puberulous; upper lip hooded, 3–5 × 5–7 mm; lower lip projecting, 14–17 × 11–15 mm, saccate in 55–65% of length; eliophore present. Stamens yellow brown, anthers 2.3–3.0 mm, dehiscing throughout, the thecae divaricate; filaments 0.7–1.0 mm. Style glabrous, 1.9–2.5 mm, curved at apex. Capsule ovoid, 5–7 mm long, shortly glandular-hirsute. Seeds ca. 0.3 mm long.

Distribution and habitat. Endemic to the eastern slopes of the Andes in northern Bolivia (Dept. La Paz); mountain scrub and upper cloud forest, known from altitudes between 2800 and 3400 m.

Calceolaria urticifolia was found in a botanically poorly explored area of the Andes during community studies in plant ecology by botanists from the university of La Paz. With regard to vegetative as well as floral morphology, it is a typical representative of *Calceolaria* sect. *Urticopsis*, a large species group in the northern and central Andes (see Molau, 1988). However, it differs from most species of section *Urticopsis* by its more or less brown-tinged and glanduliferous vestiture, reminiscent of *Calceolaria* sect. *Lehmannina*. In the latter, there is one species with ovate leaf blades with cordate bases, *Calceolaria heterophylla* Ruiz & Pavón (sect. *Lehmannina*), endemic to the Andes of central Peru. However, *C. heterophylla* possesses the typical calyx of section *Lehmannina*, the sepals having a short-tomentose border along the margin inside.

Another species co-occurring with *Calceolaria urticifolia* in the eastern slopes of the north Bolivian Andes is *Calceolaria soratensis* Kraenzlin (sect. *Polyclada*). They agree in general leaf shape, but *C. soratensis* possesses the key characters of section *Polyclada*, viz. unequal sepals with their typical short-tomentose internal border and sessile orange glands on the lower leaf surface. Furthermore, the leaf blades of that species have a white villous lower surface and deflexed margins with rounded teeth, and the cymes are only 1- to 4-flowered.

Within *Calceolaria* sect. *Urticopsis*, the closest relative to this new species is probably *Calceolaria elatior* Grisebach, which has its main distribution in southern Bolivia and northern Argentina. This species differs in many characters, e.g., its white indumentum and absence of cyme bracts.

Paratypes. BOLIVIA. **La Paz:** Inquisivi, Choquetanga Chico, descending toward Humapalca, 2800 m, 19 Aug. 1994, *N. Salinas et al. 3387* (GB, LPB).

Acknowledgments. Bente Eriksen translated the diagnoses to Latin, for which I am most grateful. I thank Stephan Beck, La Paz, for drawing my attention to new material from the forest ecology study of his group at LPB, and the curators of F and MO for continuing to send important material of *Calceolaria* to GB. Carmen Ulloa is also thanked for the Spanish resumen.

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Monarda humilis (Lamiaceae), a New Combination for a Species from New Mexico, and a Key to the Species of Section *Cheilyctis*

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ABSTRACT. A new combination, *Monarda humilis*, is established to accommodate one of the two species of *Monarda* sect. *Cheilyctis* that is found in New Mexico. This species differs from the other species in New Mexico, *M. punctata*, by its corolla pigmentation, leaf size, and more diminutive and gracile habit. A key to the six species of section *Cheilyctis* is provided, and evidence for specific status of several taxa is discussed.

Key words: Lamiaceae, *Monarda*, New Mexico, North America.

A study of *Monarda* L. specimens in the University of New Mexico Herbarium (UNM) in August 2001 revealed two morphologically distinct species of section *Cheilyctis* in New Mexico. They differ in several characters (see below), but the most conspicuous differences are that one has small leaves (2–4(5) cm long), corollas with the lower lip having deep purple spots and deep purple margins on a white background, purple upper lips, and purple bracts. The other has large leaves (4–7 cm long), corollas with a lower lip having purple or maroon spots and margins and backgrounds that are white or pale yellow in color, white or pale yellow upper lips, and white bracts.

The specimens of the large-leaved species are from eastern and southern New Mexico and are assignable to *M. punctata* L. Their large leaves, white or pale yellow corollas, white bracts, and broadly deltoid calyx teeth suggest they are best placed in variety *occidentalis* (Epling) E. J. Palmer & Steyermark (Scora, 1967). This variety is common in adjacent areas of western Texas and Oklahoma.

The specimens of the small-leaved species are from central and western New Mexico. There are no names available at the specific rank for the second taxon. However, Torrey (1853) described *M. punctata* var. *humilis* from a specimen collected within the distribution of the small-leaved species. He noted in the protologue that it may be a distinct species. The English description is very brief, and there is no Latin diagnosis, but the description is consistent with the small-leaved species. No subsequent workers took up Torrey's name. The type of *M. punctata* var. *humilis* is fragmentary and has suffered some insect damage, but close examination of the features of the stem, leaves, and calyx determined that it is conspecific with the specimens of the small-leaved species. We therefore elevate Torrey's variety *humilis* to species rank by making the new combination below and provide a description of the taxon. We also provide a key to the species of section *Cheilyctis* and briefly discuss the taxonomy of the section. In particular we review evidence for specific status of *M. fruticulosa* Epling, *M. maritima* (Cory) Correll, *M. stanfieldii* Small, and *M. viridissima* Correll.

Monarda humilis (Torrey) Prather & J. A. Keith, comb. et stat. nov. Basionym: *Monarda punctata* var. *humilis* Torrey, Report of an Expedition down to the Zuni and Colorado Rivers 166. 1853. TYPE: U.S.A. New Mexico: no date, *[S. W.] Woodhouse s.n.* (holotype, GH). Figure 1.

Annual herb, rarely branched at the base, usually branched above, 15–40(50) cm tall. Stems slender, often pigmented pink or purple, especially at the base, covered in minute, unicellular, conical, downcurved trichomes. Leaves petiolate, blades 0.3–0.7 cm wide, 2–4(5) cm long, elliptical to lanceolate, usually entire, occasionally sparsely serrate, covered in minute, unicellular, conical trichomes. Inflorescence of several verticillastrate inflorescences in axillary positions along each flowering stem. Bracts lanceolate to deltate, usually purple on their adaxial surface, usually green on the abaxial surface. Calyx tube 4–6 mm long, with tiny unicellular trichomes scattered along the veins on the outside of the tube, and a ring of long, multicellular trichomes on the internal surface of the apex of the tube, lobes ca. 1 mm long, deltate, long-ciliate, cilia of multicellular trichomes. Corolla 0.7–1.5 cm long, lower lip with deep purple spots and a deep purple margin on a white background, upper lip purple, with short hairs and sometimes a

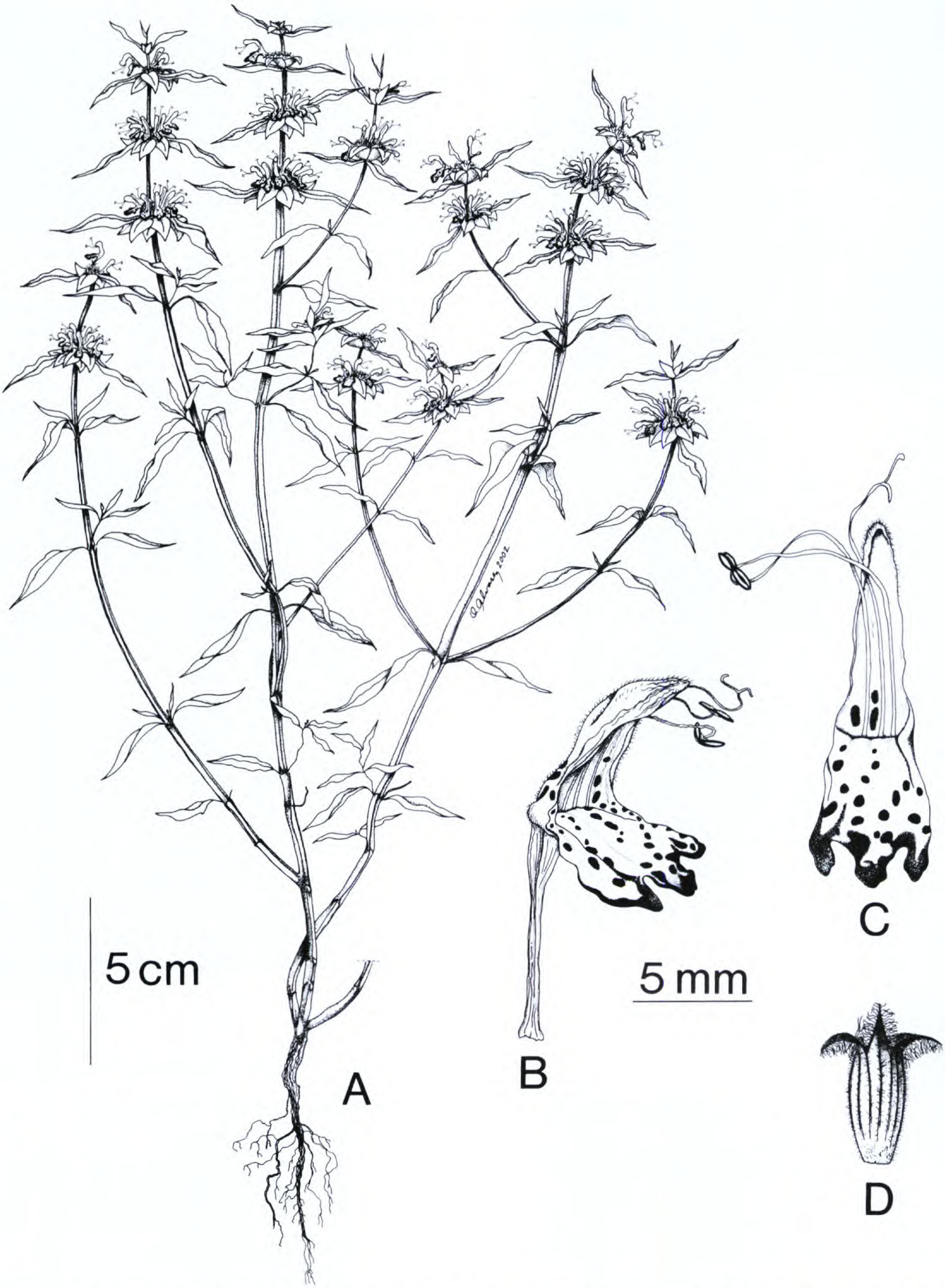

Figure 1. *Monarda humilis* (Torrey) Prather & J. A. Keith. —A. Plant. —B. Corolla, side view (detail). —C. Corolla, front view (detail). —D. Calyx (detail). Based on *Wagner 1192* (UNM).

few longer ones on the outer surface. Chromosome number $n = 12$ (Ward & Spellenberg, 1984).

Habitat and distribution. Found in very sandy soil in open areas of juniper scrub or in grassy plains or dunes in central and western New Mexico.

Phenology. Flowering June through August.

The type specimen of *Monarda punctata* var. *humilis* was collected by Woodhouse on the Sitgreaves Expedition (Torrey, 1853). Most of the type specimens from this expedition are in the herbarium at The New York Botanical Garden; however, repeated searches by NY staff did not uncover the type of *M. punctata* var. *humilis*. A specimen was found in the Gray Herbarium, and after "Monarda," written in pen, the phrase "punctata humilis Torr., Sitgreaves Rep." is written in pencil in what appears to be Torrey's handwriting, based on comparison with published examples (Daniel, 1981). This specimen, thus, is assumed to be the holotype.

The major floras of New Mexico and monographs of *Monarda* recognized only one taxon from the state, though different names had been applied to it. In the *Flora of New Mexico*, Wooton and Standley (1915) listed only *M. lasiodonta* (A. Gray) Small, placing *M. punctata* var. *lasiodonta* A. Gray in synonymy. They also stated in the text that *M. punctata* var. *humilis* is likely a synonym of *M. lasiodonta*. The only taxon of section *Cheilyctis* given in *A Flora of New Mexico* (Martin & Hutchins, 1981) is *M. punctata* var. *lasiodonta*, with *M. punctata* var. *occidentalis* and *M. lasiodonta* listed as synonyms.

In an early treatment of *Monarda* subg. *Cheilyctis*, Epling (1935) listed only *M. punctata* subsp. *occidentalis* for New Mexico. In 1931 he annotated specimens in US belonging to both New Mexican species as *M. punctata* subsp. *occidentalis* (*M. humilis*: *Wooton s.n.*, 1 Aug. 1892; *Wooton s.n.*, 26 July 1906. *M. punctata* var. *occidentalis*: *Fisher 181*; *Wooton 424*; *Wooton s.n.*, 14 Aug. 1895; *Vasey s.n.*, Aug. 1881). He did not cite any specimens in the 1935 treatment, but he noted that some of these specimens were atypical and stated (Epling, 1935: 26): "The New Mexican and Mexican forms appear to have rose-purple corollas spotted with a deeper purple. They are too little known." Likewise, McClintock and Epling (1942) listed *M. punctata* subsp. *occidentalis* as the only taxon of section *Cheilyctis* in New Mexico, but they cited two specimens of *M. humilis* as examples of a "dwarf form." Scora (1967) listed *M. punctata* var. *occidentalis* as the only taxon in New Mexico, but he cited only one specimen from the state. That specimen (*Vasey s.n.*, Aug. 1881, US) is *M. punctata* var. *occidentalis*. Scora listed *M. punctata* var. *humilis* in synonymy under *M. pectinata* Nuttall, but examination of the type clearly does not support that placement; the type specimen clearly lacks the long aristate calyx lobes typical of *M. pectinata* and all other species of section *Aristatae*. Torrey, in fact, noted in the protologue that the shape of the calyx teeth of *M. humilis* are "triangular lanceolate, short."

Even though the names *Monarda lasiodonta* or *M. punctata* var. *lasiodonta* have been applied to New Mexican specimens (Wooton & Standley, 1915; Martin & Hutchins, 1981), and the type of variety *humilis* is a syntype of variety *lasiodonta*, the latter taxon is best interpreted as being absent from New Mexico. While Gray's original interpretation of *M. lasiodonta* was quite broad, including plants from Arizona, New Mexico, and Texas (Gray, 1886), current authors treat *M. punctata* var. *lasiodonta* as an eastern Texas plant (Shinners, 1953; Scora, 1967; Turner, 1994), and the taxon has been lectotypified with a Drummond collection from Texas (Scora, 1967).

The two taxa in New Mexico can be distinguished by several characters, though in a few features they intergrade. *Monarda humilis* is usually a smaller, more slender plant and the specimens tend to be more pigmented with purple in general, especially in the stems, bracts, calyx, and corolla. *Monarda punctata* var. *occidentalis* is usually more robust and lacks the purple pigmentation in the stems, bracts, and calyx, and the corollas are less pigmented than those of *M. humilis*. The leaves of *M. humilis* are smaller and entire or weakly toothed, while those of *M. punctata* var. *occidentalis* are larger and usually distinctly toothed. The flowers differ in pigmentation as discussed above, and they are further distinguished by pubescence of the upper lip: in *M. humilis* the outer surface of the upper lip has only short hairs or short hairs plus a few long hairs, while in *M. punctata* var. *occidentalis* the upper lip usually has many long hairs, in addition to short hairs.

Monarda humilis can be distinguished from the other species in section *Cheilyctis* most easily by the pattern and color of its corolla. The dried flowers of this species are heavily tinted with purple, which is uncommon in the section. Flowers of other species in the section are usually yellow, pink, or white. The purple spots on the lower lip in *M. humilis* are larger and more irregular than the maroon spotting (when present) on the other taxa. *Monarda humilis* is the only species in the section that has a purple upper lip. Others may have maroon spots on the upper lip (particularly *M. stanfieldii* and many populations of *M. punctata*), but in none is

the background color purple. In *M. humilis*, the margins and tip of the lower lip are colored deep purple, while in other species the margin is the same in color as the background (white, yellow, or pink). Only in the case of *M. fruticulosa* is the lower lip margin sometimes tinted pale lavender or pink, but it is never as dark as *M. humilis*. The leaves of *M. humilis* are 2–4(5)cm long, while those of *M. punctata* are typically 4–7 mm long. As indicated by Torrey's epithet and by McClintock and Epling's (1942) reference to specimens belonging to this taxon as a "dwarf form," these plants are also much smaller (15–40(50) cm) and more gracile than typical *M. punctata*.

In addition to the morphological features, *M. humilis* has a different chromosome number than most other taxa in section *Cheilyctis*. *Monarda fruticulosa* and *M. punctata* vars. *arkansana*, *coryi*, *immaculata*, and *intermedia* all are $n = 11$ (Scora, 1967). The chromosome number of the midwestern and northeastern *M. punctata* var. *villicaulis* has been reported to be $n = 11$ or 12 (Bushnell, 1936; Scora, 1967; Gill, 1977). The chromosome number of *M. humilis* is $n = 12$ (as *M. punctata* var. *occidentalis*, voucher: *Ward & Spellenberg s.n.*, 13 Aug. 1981 (NMC); Ward & Spellenberg, 1984).

Additional material seen: U.S.A. **New Mexico:** Sandoval Co., Santo Domingo Pueblo, *Abbott s.n.*, 10 July 1936 (UNM); McKinley Co., Zuni Indian Reservation, 1.5 mi. E of Blackrock, 0.5 mi. NE of Blackrock Reservoir, T10N, R18W, Sec. 18, *Brandt 1094* (UNM); Cibola Co., El Morro National Monument, *Carlson & McCallum SC4* (UNM); Cibola Co., T7N, R10W, Sec. 8, *DeBruin 448* (UNM); Socorro Co., T3S, R4W, Sec. 20, *Goodrow 522* (UNM); Socorro Co., plains E of Datil on hwy. 60, *Higgins 7737* (NMC); Socorro Co., between Datil & Magdalena on roadside, hwy. 60, *Jafoya 131* (UNM); Catron Co., North Cebollita Mesa, T8N R9W Sec. 8, *McIntosh 1006* (NMC); Socorro Co., 10 mi. S of Claunch on state hwy. 55, *Pase 3566* (NMC); Torrance Co., Cibola National Forest, Gallinas Mountains, Forest Road 458, *Pase 3621* (NMC); Socorro Co., Plains of San Augustin, 18 mi. W of Magdalena on hwy. 60 at mile marker 94, *Sivinski 4062* (UNM); Torrance Co., 3 mi. E of Gran Quivera, *Spellenberg et al. 3408* (NMC, US); Valencia Co., El Morro National Monument, *Vogt 7* (ARIZ); Gran Quivera National Monument, NW section of mall, *Toulause s.n.*, 19 June 1940 (ARIZ); Socorro Co., 9 mi. W of Magdalena on hwy. 60, *Wagner 1192* (UNM); Cibola Co., 10 mi. S of I-40, E edge of Grant Malpais, roadside of NM-117, T8N, R9W, Sec. 6, *Ward & Spellenberg s.n.*, 13 Aug. 1981 (NMC); Cibola Co., mountains W of Grant's Station, *Wooton 310* (NMC); [Cibola Co.], Inscription Rock, *Wooton s.n.*, 1 Aug. 1892 (US-2); Grant Co., W of San Lorenzo, *Wooton s.n.*, 26 July 1906 (NMC, US-2); Socorro Co., near Catron Co. line E of Datil, along US hwy. 60, *Zimmerman & Zimmerman DAZ-ADZ 2746* (ARIZ).

Summary of *Monarda* sect. *Cheilyctis*

The genus *Monarda* (Lamiaceae) consists of 19 species that are distributed in North America from the Rocky Mountains to the Atlantic Coast and from Canada to central Mexico. The six species of section *Cheilyctis* are distributed in eastern North America from the East Coast to western New Mexico, as far north as southern Canada, as far south as northern Mexico. The species of section *Cheilyctis* lack rhizomes, have elliptical to linear leaves, more or less foliar bracts, several verticillastrate inflorescences along each flowering stem, corollas that have a throat much shorter than the tube and a markedly arcuate upper lip, included stamens, 13-veined calyces with deltate lobes, and chromosome numbers of $n = 11$ or 12 (Prather et al., 2002). The taxa of the section are predominantly herbs, but one species is a shrub.

Key to the Species of *Monarda* sect. *Cheilyctis*, Adapted in Part from Correll and Johnston (1970)

1a. Plants fruticose or suffruticose perennials; stems densely leaved, average internode length between 1 and 3.5 cm.
  2a. Upper stems densely pilose with spreading hairs; leaf margins coarsely serrate from below the mid-lamina to the apex, abaxial surface pilose throughout; floral bract margins serrate from the mid to upper lamina; distributed near the southern Texas coastline . . . . . *Monarda maritima*
  2b. Upper stems puberulent with appressed or recurved hairs; leaf margins entire to sparsely serrulate from the mid-lamina to the apex, abaxial surface canescent to pilose toward the leaf base; floral bract margins entire or rarely toothed; distributed in southern or south-central Texas.
    3a. Fruticose perennial; leaves linear, leaf indumentum canescent, leaf color cinereous, apex obtuse to acute; distributed in southern Texas . . . . . *Monarda fruticulosa*
    3b. Suffruticose perennial; leaves linear-lanceolate, leaf indumentum puberulent to sparsely pilose, leaf color green, apex sharply acute; distributed in south-central Texas . . . . . *Monarda viridissima*
1b. Plants herbaceous perennials or annuals; stems laxly leaved, average internode length between 3.5 and 8 cm.
  4a. Orifice of the calyx densely hirsute, completely enclosed by a dense tuft of hairs forming a cone above the opening; leaves broadly lanceolate, 6–8 cm in length, 1.5–2 cm wide; distributed in central Texas . . . . . *Monarda stanfieldii*
  4b. Orifice of the calyx glabrous to bearded, not enclosed by hairs; leaves lanceolate to linear-lanceolate, 7 cm or less in length, 0.3–1.5 cm wide; distributed across the eastern half of North America and west to New Mexico.
    5a. Upper lip of corolla lavender to purple, unspotted, lower lip white with irregular purple spots and a nearly continuous

purple margin; leaves 2–4(5) cm long; New Mexico endemic . . . . . *Monarda humilis*

5b. Upper lip of corolla white, yellow, or pink, often with maroon spots, lower lip white, yellow, or pink with or without maroon spots and a margin the same color as the corolla background; leaves 4–7 cm long; distributed widely across the central and eastern half of North America . . . . . *Monarda punctata*

The new species brings the total number of species in section *Cheilyctis* to six, but the rank of several taxa in section *Cheilyctis* has been disputed. Epling (1935) and McClintock and Epling (1942) recognized two species in section *Cheilyctis*, *Monarda fruticulosa* and *M. punctata*. In the former treatment, *M. punctata* was considered to have four subspecies, and in the latter it was treated as having eight. In the most recent comprehensive treatment, Scora (1967) treated the complex as a single species, *M. punctata*, with 11 varieties. More recently, Turner (1994) treated the *Monarda* of Texas and Mexico and recognized five species in the section: *M. fruticulosa*, *M. maritima*, *M. stanfieldii*, *M. viridissima*, and *M. punctata* with five varieties that occur in the region included in the treatment. *Monarda viridissima* was described in the interim between Scora's (1967) and Turner's (1994) treatments (Correll, 1968). Scora (1967) treated the other three species recognized by Turner as varieties of *M. punctata*. In a recent publication on the phylogeny of *Monarda*, Prather et al. (2002) recognized three species of section *Cheilyctis*, *M. fruticulosa*, *M. punctata*, and *M. viridissima*. However, recent field and herbarium studies have suggested that Turner's taxonomy of the section is more appropriate, and that varieties *maritima* and *stanfieldii* are best treated as species (see below).

Monarda punctata is a widespread and highly variable species. For discussions on the morphological variation and taxonomic treatment of the infraspecific taxa refer to Turner (1994) or Scora (1967). *Monarda humilis* is discussed above. The other four taxa, *M. fruticulosa*, *M. maritima*, *M. stanfieldii*, and *M. viridissima*, are narrowly distributed edaphic endemics found only in Texas.

Monarda fruticulosa is the only true shrub in the genus. It is also characterized by its linear, canescent leaves and young stems, and by its pink bracts. It is endemic to the sand plains of southern Texas in Brooks, Duval, Jim Hogg, Hidalgo, Kenedy, and Zapata counties. All authors (e.g., McClintock & Epling, 1942; Correll & Johnston, 1970; Turner, 1994) except Scora (1967) agree that this well-marked taxon merits species recognition. Scora treated it as a variety of *M. punctata*.

Monarda viridissima and *M. maritima* are distinguishable from the other taxa in the section by their robust suffrutescent habit and fall blooming period. These two taxa may be closely related, but they can be easily distinguished. *Monarda maritima* has long (1–3 mm), spreading, pilose trichomes scattered along the stem and abaxial leaf surface while the pubescence of *M. viridissima* is composed of much shorter trichomes (≤ 1 mm). Furthermore, *M. maritima* has lanceolate, strongly serrate leaves, while *M. viridissima* has linear-lanceolate, entire to weakly toothed leaves. *Monarda maritima* is endemic to the Live Oak Belt of coastal southern Texas and occurs in Aransas, Kleberg, and Refugio Counties. Some authors have treated *M. maritima* as a variety of *M. punctata* (Shinners, 1953; Scora, 1967), but others have recognized it at the species level (Correll & Johnston, 1970; Turner, 1994). *Monarda viridissima* occurs in the Carrizo Sands of central Texas and has been reported from Bastrop, Caldwell, Goliad, Lavaca, Milam, and Wilson Counties. Field studies in spring 2001, in combination with herbarium studies, strongly suggest that both *M. maritima* and *M. viridissima* merit species recognition. Both species sometimes occur sympatrically with *M. punctata* and when they do, they remain morphologically and phenologically distinct (Turner, 1994; Prather, pers. obs.).

Monarda stanfieldii is characterized by a dense ring of stiff, erect trichomes at the apex of the calyx tube. These trichomes are found on the inner surface only. They project inwardly and form a cone that closes off access to the calyx orifice. Furthermore, this species has distinctly yellow flowers that have dense maroon spotting on the upper surface, and leaves that are longer and wider than most other taxa in section *Cheilyctis*. *Monarda stanfieldii* is endemic to the granitic sands of the upper Colorado River drainage in the Texas Hill Country and is found in Llano and Travis Counties. Like *M. maritima*, some authors have treated this as an infraspecific taxon in *M. punctata* (Scora, 1967; Correll & Johnston, 1970), but Turner (1994) recognized it at the species level. It is not known to occur sympatrically with any other taxon in the section. The appropriate rank for *M. stanfieldii* is problematic, but the dense ring of trichomes distinguishes the taxon from all other taxa, and serves as a putative autapomorphy; therefore it is our opinion that currently it is best treated as a species.

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UNM, and US. The curators at NY kindly made several searches for the type of *M. humilis*. Robert Sivinski and Richard Spellenberg made many helpful improvements to the manuscript. We especially thank Orlando Alvarez-Fuentes for providing the illustration and Richard Spellenberg for bringing our attention to the chromosome count.

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A New *Miconia* (Melastomataceae) from Bolivia, with Remarks on Angular-branched Species in the Andes

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ABSTRACT. A new species of Melastomataceae from Bolivia is described, illustrated, and placed in a phenetic context within *Miconia*, a genus of 1000 species and about 2000 published names. *Miconia quadrialata* is readily distinguished from its congeners by two-colored leaves and sharply four-angular and winged branchlets. A search for quadrangular-branched miconias revealed that 12 of 15 such species (in four sections), including the new species, occur in cloud forest in the Andes, raising the question of the adaptive significance of quadrangular branchlets.

Key words: adaptive significance, Andes, angular branches, Bolivia, Melastomataceae, *Miconia*, montane forest.

In the context of an ongoing floristic project at the Missouri Botanical Garden, the first author visited the Bolivian National Herbarium in La Paz (LPB) and the National Herbarium in Washington (US), which together contain the most complete collections of Bolivian and Neotropical Melastomataceae. These visits, and an excursion in the La Paz area, brought to light material of a new species of *Miconia* Ruiz & Pavón. *Miconia* is among the largest genera of flowering plants, with 1000 species in the best-curated collection (US) and some 2000 published names. In addition, *Miconia* is unlikely to be monophyletic (Michelangeli, 2002), and several medium-sized genera, such as *Clidemia* D. Don, *Leandra* Raddi, *Ossaea* DC., and *Tococa* Aublet, may have arisen from within it. The entire genus is unlikely to ever be revised, and over the past 100 years, it has gradually become a black hole in which species are described never to be found again. The new species described here can only be placed in a phenotypic and geographic context. It is known from seven collections, all made within a few hours by car from La Paz, the first by Alwyn Gentry and colleagues 18 years ago. Over the past 11 years, the second author collected fertile material in various stages and has sought to determine the species' ecological amplitude. The two-colored leaves and sharply four-winged branches (see color photo at http://www.umsl.edu/~biosrenn/ under Melastomataceae: Taxonomy) of *M. quadrialata* are highly distinct, and after searching through type collections, photos, and protologues at US, we feel confident that it has not already been named.

Miconia quadrialata Renner & Beck, sp. nov. TYPE: Bolivia. La Paz: Prov. Nor Yungas, Chuspipata, hacia ex Estación Ferrocarril, Campamento Andrade, 16°18′S, 67°48′W, 3010 m, 21 Oct. 2001, *S. G. Beck 25988* (holotype, LPB; isotypes, AAU, CAS, MO, US). Figure 1.

Distinctissima foliis coriaceis discoloribus subtus albis vel stramineis ramisque quadrangularibus.

Shrub or treelet, to 7 m tall; young branchlets sharply quadrangular, sometimes subsulcate, winged, the wings 1–2 mm wide; branchlets, inflorescences, and hypanthia glabrous. Leaf blades 11.5–15 × 6–7 cm, 3-nerved, elliptic, the apex shortly acuminate, rarely obtuse, the base acute or obtuse, rigid chartaceous, above glabrous, below covered by an appressed tan to white cobwebby minute dentritic-stellulate pubescence, the margin often drying slightly revolute; petioles (0.5)1–2 cm long. Panicle 8–13 cm long, with decussate branchlets. Floral hypanthium 3.5–4 mm long, the calyx lobes 1 mm long, persistent long after anthesis; petals 5, white, about 2 mm long and 1.5 mm broad, their apex emarginate; stamens isomorphic, white; the anthers 1.6–2 mm long, truncate and bi-porate, the connective simple, not lobed or appendaged. Berries subglobose, mature blue, dry 5–6 mm diam.

Figure 1. *Miconia quadrialata* Renner & Beck, drawn from *Beck & Renner 25967* and *Beck 25988* (MO). —a. Habit. —b. Branchlet. —c. Flower. —d. Stamens.

Distribution, habitat, and phenology. *Miconia quadrialata* is only known from the Nor Yungas in Bolivia, where it occurs in cloud forests at 2500–3100 m alt. with species of *Freziera* Willdenow (Ternstroemiaceae), *Weinmannia* L. (Cunoniaceae), *Hedyosmum* Swartz (Chloranthaceae), as well as many Eriaceae and other Melastomataceae. Most collections so far come from rocky outcrops. *Mi-*

conia quadrialata flowers between mid August and November, and fruits from January to May. The Yungas formation is restricted to west-central Bolivia and extreme southeastern Peru and is characterized by constant high humidity from water droplets and rain deposited by northern trade winds (Beck et al., 1993).

Etymology. The epithet alludes to the species' 4-angular and winged branchlets.

Miconia quadrialata is unique in combining whitish or tan lower leaf surfaces with sharply quadrangular branchlets that have 1–2 mm wide wings. In leaf shape and venation, it resembles the Peruvian *M. floccosa* Cogniaux, but that species has obtusely quadrate branches that are densely covered with a felt-like stellate tomentum, which also covers the lower leaf surfaces. Thorough searches in MO and US revealed that 14 other species of *Miconia* have strongly quadrangular (sometimes in addition winged or sulcate) stems, but that none at the same time have bi-colored leaves. The geographic and altitudinal ranges of the 14 quadrangular-branched species (given below) suggest that this character may be particularly common in montane forests, although four of the species also occur below 500 m. An intriguing question is what may select for the evolution of angular and winged branches, and if as many instances of parallel evolution are involved as suggested by the current assignment of these species to 4 of the 11 sections of *Miconia* (Cogniaux, 1891). A possible adaptive value (T. Feild, pers. comm., May 2002) is that the square internodes relate to how branchlets break during trauma. Many Chloranthaceae in similar habitats also have square stems coupled with septate-modular branchlets, such that they break in predictable ways when traumatized by falling canopy debris. (The 14 quadrangular-branched species of *Miconia* so far known are *M. alata* DC. from 50 to 1000 m alt. in Venezuelan Amazonia and adjacent Brazil; *M. aligera* Wurdack from cloud forest at 2080 m in the department of Cuzco, Peru; *M. dissimulans* Wurdack from cloud forest at 2700–3350 m in southern Ecuador; *M. flaccida* Gleason from 1200 to 1900 m in Huánuco and Pasco, Peru; *M. floccosa* Cogniaux from 2500 to 3000 m in Pasco; *M. glutinosa* Cogniaux from 2400 m in Puno, Peru; *M. incachacana* Wurdack from 2200 m in Cochabamba, Bolivia; *M. monzoniensis* Cogniaux from 2400 m in Huánuco [this includes *M. pterogona* Gleason]; *M. pterocaulon* Triana from 120 to 950 m in Costa Rica, Venezuela, Colombia, Ecuador, and Peru; *M. quadrangularis* (Swartz) Naudin from 500 to 2300 m in Jamaica; *M. reducens* Triana from 50 to 1500 m in Nicaragua southeast to Ecuador and Venezuela; *M. robinsoniana* Cogniaux from 400 to 500 m elevation on the Galapagos islands but also occurring at 2500–3000 m in Panama; *M. subnodosa* Triana from 150 to 1700 m in Colombia, Ecuador, and Bolivia; and *M. sulcata* Macbride from around 2000 m in Junín, Peru. At least three of the listed species, *Miconia reducens, M. robinsoniana,* and *M. subnodosa,* are part of a messy species complex that also includes *M. aponeura* Triana from 1400 m in central Colombia, with winged internodes [F. Almeda, pers. comm.]. Sharply two-winged branchlets are known from *M. micayana* Wurdack [= *Amphitoma flavescens* Gleason], occurring from 1800 to 2300 m in Cauca, Colombia, and from *M. paradoxa* Triana, occurring from 500 to 1000 m Minas Gerais, Brazil.)

Paratypes. BOLIVIA. **La Paz:** Nor Yungas, near Chuspipata, 2800 m, 13 Jan. 1984, *Gentry et al. 44195* (LPB, MO, US); 22.5 km above Yolosa towards Chuspipata, 2560 m, 27 Feb. 1990, *Beck 14995* (LPB, US); past Unduavi, Cotapata, 1 hr. along downhill trail, 3100 m, 29 May 1994, *Beck 21386* (LPB, US); past Unduavi, Cotapata, 3000 m, 11 Sep. 1994, *Beck 21457* (LPB, M, MO, NY, QCA US); between Cotapata and Chuspipata, 3000 m, 2 Nov. 1996, *Beck 22775* (LPB, US), Cotapata, 3000 m, 5 Aug. 2001, *Beck & Renner 25967* (LPB, MO).

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A New Species of *Parathesis* (Myrsinaceae) from Honduras

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ABSTRACT. While preparing the treatment of Myrsinaceae for the *Flora Mesoamericana* a new species of *Parathesis* was discovered from Olancho, Honduras. *Parathesis pipolyana* is described and illustrated, and its phylogenetic relationships are discussed.

RESUMEN. Al preparar un tratamiento taxonómico de la familia Myrsinaceae para *Flora Mesoamericana,* se descubrió una nueva especie perteneciente al género *Parathesis* proveniente de Olancho, Honduras. Se describe e ilustra *Parathesis pipolyana,* y se discute su parentezco.

Key words: *Flora Mesoamericana,* Honduras, Myrsinaceae, Olancho, *Parathesis.*

The genus *Parathesis* (A. DC.) Hooker f. contains 92 species distributed from northern Mexico to Panama, the Caribbean basin, and throughout the Andes from Venezuela to Bolivia as well as adjacent Brazil. The genus is defined by the unique glandular papillae of the calyx and corolla lobes and bright yellow anthers. In preparation for the treatment of *Parathesis* for *Flora Mesoamericana,* a new species from Honduras was discovered; it is described herewith.

Parathesis pipolyana Ricketson, sp. nov. TYPE: Honduras. Olancho: alrededor de El Filo, 15 km al NO de Catacamas, en el Parque Nacional de Agalta, 14°59′N, 85°56′W, 1920 m, 1 June 1992 (bud), *D. Mejía 135* (holotype, MO; isotype, EAP not seen). Figure 1.

Propter inflorescentiam lateralem, ramulos rhachidesque inflorescentiarum etiam laminas foliorum subtus dense grosseque stipitato-stellato- vel glandulari-villosotomentosos, necnon laminas membranaceas secus margines dentatas vel serratas *P. vestitae* valde arcte affinis, sed ab ea trichomatibus rufis (non ferrugineis) stipitati-dendroideis (nec longi-villosis), denique laminarum nerviis secundariis 13 ad 25 (non 25 ad 3)-jugis statim distinguitur.

Trees 20 m tall. *Branchlets* slender, angulate, 3–7 mm diam., densely and coarsely tomentose, the indument composed of rufous stalked stellate trichomes. *Leaves* with blades membranous, elliptic to oblong-elliptic, 14.6–18.1 × 4.6–7.1 cm, apically acute to acuminate, with an acumen 0.7–1.5 cm long, basally acute to obtuse, decurrent on the petiole, conspicuously and prominently punctate and punctate-lineate, sparsely to densely stalked stellate tomentellous to tomentose over the majority of the blade, not bizonal, the stalked stellate hairs often breaking off apically and then appearing like glandular-villous hairs, but always densely tomentose along the midrib above and below, the midrib impressed above, prominently raised below, the secondary veins 13 to 25 pairs, conspicuously impressed above, prominently raised below, the margins serrate to dentate and mostly densely tomentellous; petiole slender, marginate, 1.7–2.8 cm long, densely tomentose. *Inflorescences* lateral, bi- to tripinnately paniculate, 7–14 × 2.5–5.5 cm, pyramidal, shorter than the leaves, the rachis densely mixed tomentose of rufous papillae and sessile, short or long stipitate dendroid trichomes, the branches 3- to 9-flowered corymbose; peduncles 4.4–6.2 cm long; inflorescence bracts unknown; inflorescence branch bracts unknown; floral bracts caducous, membranous, lanceolate, 1.2–1.8 × 0.4–0.5 mm, apically acute, basally sessile, conspicuously and prominently punctate and punctate-lineate, glabrous adaxially, sparsely rufous sessile dendroid tomentellous abaxially, the veins inconspicuous, the margins entire; pedicels in bud slender, angulate, 2–4 mm long, conspicuously and prominently punctate and punctate-lineate, indument of mixed rufous papillae, sessile or short stipitate multicellular dendroid trichomes. *Flowers* 5-merous, the following measurements from buds: calyx in bud membranous, 1.7–1.9 mm long, the tube 0.1–0.3 mm long, the lobes ovate to lanceolate, 1.5–1.7 × 0.6–0.8 mm, apically acute, conspicuously and prominently punctate and punctate-lineate, glabrous adaxially, sparsely to scattered mixed tomentellous abaxially, the indument consisting of glandular papillae and sessile or short stipitate-dendroid trichomes, the margins entire; corolla whitish, in bud chartaceous, 2–2.3 mm long, the tube 0.3–0.4 mm long, the lobes lanceolate, 1.8–2 × 0.7–0.8 mm, apically attenuate, conspic-

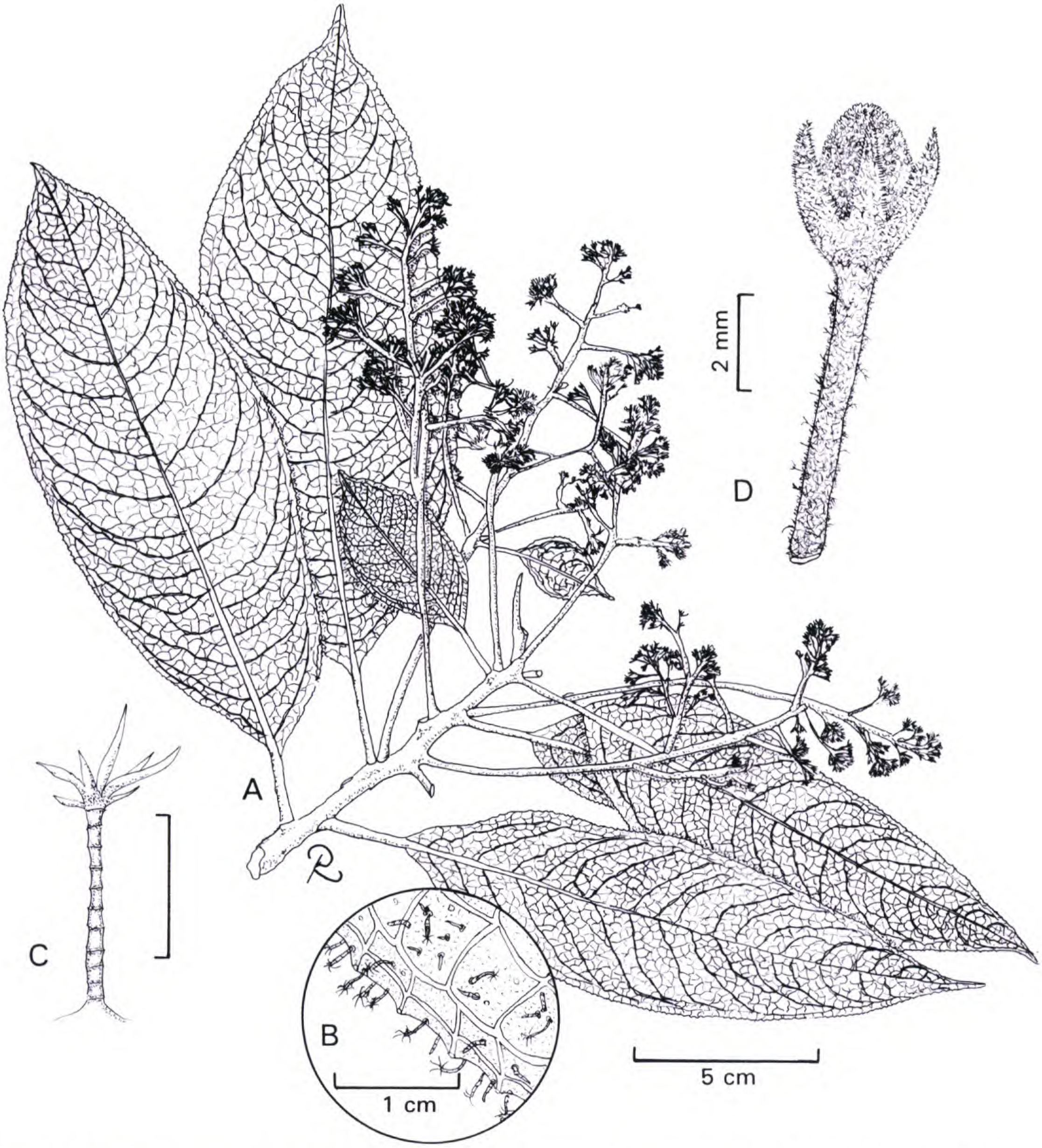

Figure 1. *Parathesis pipolyana* Ricketson. —A. Flowering branch. —B. Detail of abaxial leaf surface. —C. Rufous stalked stellate trichome. —D. Flower in bud. A–D drawn from holotype, *D. Mejía 135* (MO).

uously and prominently punctate and punctate-lineate, the rufous glandular papillae dense along the margins and apically, glabrous at the base within, densely rufous glandular papillate without, the margins entire; stamens 1.7–1.8 mm long, the filaments 0.5–0.6 mm long, the staminal tube to 0.1 mm long, the apically free portion 0.4–0.5 mm long, conspicuously and prominently punctate and punctate-lineate, glabrous, the anthers yellow, erect, basifixed, lanceolate, 1.6–1.7 × 0.5–0.6 mm, apically acute, apiculate, basally cordate, the connective conspicuously and prominently punctate and punctate-lineate; pistil 1.8–2.2 mm long, the ovary ovate, 0.7–0.8 mm long, conspicuously and prominently punctate and punctate-lineate, glabrous except apically with scattered to densely rufous pubescence, the style 1.2–1.4 mm long, conspicuously and prominently punctate and punctate-lineate, glabrous except basally with scattered rufous trichomes, the ovules 5 or 6, uniseriate. *Fruits* unknown.

Distribution. *Parathesis pipolyana* is known only from the type collection from the Parque Na-

cional de Agalta, Olancho, Honduras, growing at 1920 m elevation.

Ecology. This species was collected in montane evergreen tropical forest, dominated by *Quercus* and *Chusquea.* At the present time, the *Pinus* species that are also important in this type of forest are under attack from a beetle, resulting in relatively more open canopies and drier conditions (John Pipoly, pers. obs.). Owing to this situation, the species is very likely under threat.

Etymology. It gives me great pleasure to dedicate this new species to my former supervisor, now colleague and mentor in Myrsinaceae, but most importantly, friend, John J. Pipoly, III, of the Fairchild Tropical Garden (FTG). John began his work at Michigan State University (MSC) under John Beaman, then completed his doctorate at The New York Botanical Garden (NY) on the systematics of *Cybianthus* subg. *Grammadenia* (Myrsinaceae). He presently is the Director of Research at Fairchild Tropical Garden (FTG), and has conducted extensive fieldwork in the Neotropics. His numerous publications on the Myrsinaceae will become standard references for the family for years to come. I am constantly amazed at his knowledge, understanding, and insights concerning this interesting family.

Parathesis pipolyana belongs to a group of species within *Parathesis* with lateral (axillary) inflorescences, erect anthers, and the indument of the branchlets and undersurface of the leaf blades consisting of coarse and conspicuous, distinct rufous trichomes. The trichomes in this group may be simple, sessile or stipitate dendroid, or sessile, subsessile, or stipitate stellate with erect and spreading rays.

Parathesis pipolyana is similar to *P. vestita* Lundell in its dentate leaf margins, dense indument throughout, and lateral (axillary) inflorescences, but differs by the nature of the indument of the leaf margins and in the size of the teeth along the leaf margins. In *Parathesis vestita,* the indument of the branchlets, leaf blades, petioles, and inflorescences consists mostly of long ferrugineous villous hairs and rarely includes long stipitate-bifid or stipitate-dendroid hairs; the indument is less dense on the midrib and secondary veins. In *P. pipolyana* the indument has more densely matted, erect, rufous stipitate-stellate hairs. In *Parathesis vestita* the adaxial leaf blade margins are glabrate or with widely scattered, short, simple hairs and have large teeth, whereas in *P. pipolyana* the leaf margins have scattered, stout, simple to rarely stipitate-stellate hairs, these hairs 0.5–0.8(–1) mm long and set between small teeth. The density and length of the trichomes of *Parathesis pipolyana* is similar only to those found in *P. sessilifolia* Donnell Smith; however, *P. pipolyana* is immediately distinguished from that species because its inflorescence is lateral rather than terminal as in *P. sessilifolia.*

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A Newly Described Species of *Microlicia* (Melastomataceae) from Minas Gerais, Brazil

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ABSTRACT. Another species in *Microlicia* (Melastomataceae) is described and illustrated. *Microlicia obtusifolia* is known from the rocky slopes of Diamantina, Minas Gerais, Brazil. *Microlicia obtusifolia* Cogniaux ex R. Romero is distinguished from affined species (*M. pusilla* Cogniaux) by its obovate, 1- to 3-nerved leaves with obtuse apices and attenuate bases.

Key words: Brazil, "campo rupestre," endemic, highland vegetation, Melastomataceae, *Microlicia*, Minas Gerais.

The Neotropical genus *Microlicia* D. Don consists of approximately 170 species occurring mainly throughout central and eastern Brazil (Wurdack, 1993) with ca. 100 endemic species in the states of Minas Gerais, Goiás, and Bahia. During preparation of a treatment of *Microlicia* sect. *Pseudomicrolicia* Cogniaux, two specimens were found with an unpublished name that had been annotated by A. Cogniaux on the label.

Microlicia obtusifolia Cogniaux ex R. Romero, sp. nov. TYPE: Brazil. Minas Gerais: Diamantina, subida para o Cruzeiro, 11 Jan. 1963, *A. P. Duarte & G. M. Barroso 7858* (holotype, HB; isotype, NY). Figure 1.

Suffrutex 50–60 cm altus. Caulis subteres, glaber. Ramuli primum punctato-glandulosi demum glabriusculi. Laminae sessiles vel brevibus petiolis, erectae, obovatae, apice obtuso, base attenuata, margine integerrima raro inconspicuo-crenulata, supra et subtus impresso-punctatae, 1–3-nerves. Hypanthium trichomatibus glandulosis pedicellaribus ad apices. Petala magentea, apice curto-acuminato. Ovarium 3-loculare.

Microliciae pusillae maxime affinis sed praecipue lamina folii obovata, apice obtuso, base attenuata diversa.

Erect subshrub, 50–60 cm tall, branching dichotomously or trichotomously, young branches fastigiate, quadrangular, glutinous, covered with sessile glands, older branches brown, quadrangular, without leaves at the base, leaf scars conspicuous, glabrescent. Leaves sessile or with short flattened petiole to 0.5 mm, imbricate, erect, plane, blades 4–7 × 2–4 mm, obovate, apex obtuse, base attenuate and slightly constricted, margin entire or inconspicuously crenulate, hyaline, covered with sessile glands on both surfaces, glutinous or not, 1- to 3-nerved, with inconspicuous lateral veins. Flowers 5-merous, sessile or almost sessile, solitary, terminal or grouped in the branch apex. Hypanthium 2.0–2.5 × ca. 2.5 mm, campanulate, with stalked and sessile glands, on the apex with dense stalked glands, eventually with caducous glands. Calyx lobes 3.5–5.5 mm long, lanceolate, apex acute, apiculate or not, covered with stalked glands. Petals 8–9 × ca. 6 mm, magenta, obovate, apex asymmetrically acute, briefly acuminate, glabrous. Stamens 10, dimorphic. Larger stamens 5, filaments 3.5–4.0 mm long, purple, thecae 2.0–2.5 mm long, purple, oblong, not corrugate, with rostrum ca. 0.5 mm long, white, prolonged connective 3.0–3.3 mm, purple, with ventral appendage ca. 1 mm long, yellow, expanded and truncate; smaller stamens 5, filaments 3.5–4.0 mm long, purple, thecae 1.5–2.0 mm long, yellow, oblong, not corrugate, with rostrum 0.2–0.3 mm long, prolonged connective 1.2–1.5 mm, yellow, with ventral appendage 0.3–0.5 mm long, obtuse. Ovary superior, 3-locular, glabrous; style ca. 6 mm long, filiform, glabrous, stigma punctiform. Capsule ca. 3 × 3–5 mm, greenish brown, globose, the superior portion (almost 1/3) of the mature ovary not covered by the hypanthium and loculicidally dehiscent in the upper part. Seeds 0.6–0.7 × ca. 0.3 mm, numerous, slightly curved, foveolate.

Microlicia obtusifolia is endemic to the region around Diamantina, Minas Gerais, Brazil, on rocky slopes. According to specimen labels, this species flowers in January and April, and fruits in March and November.

Microlicia obtusifolia resembles *M. pusilla* Cogniaux, which occurs sympatrically in Diamantina. Both have dense stalked glands in the hypanthium apex and in the calyx lobes. The obovate leaves with an obtuse apex and attenuate, slightly constricted base with 1 to 3 veins distinguish *M. ob-*

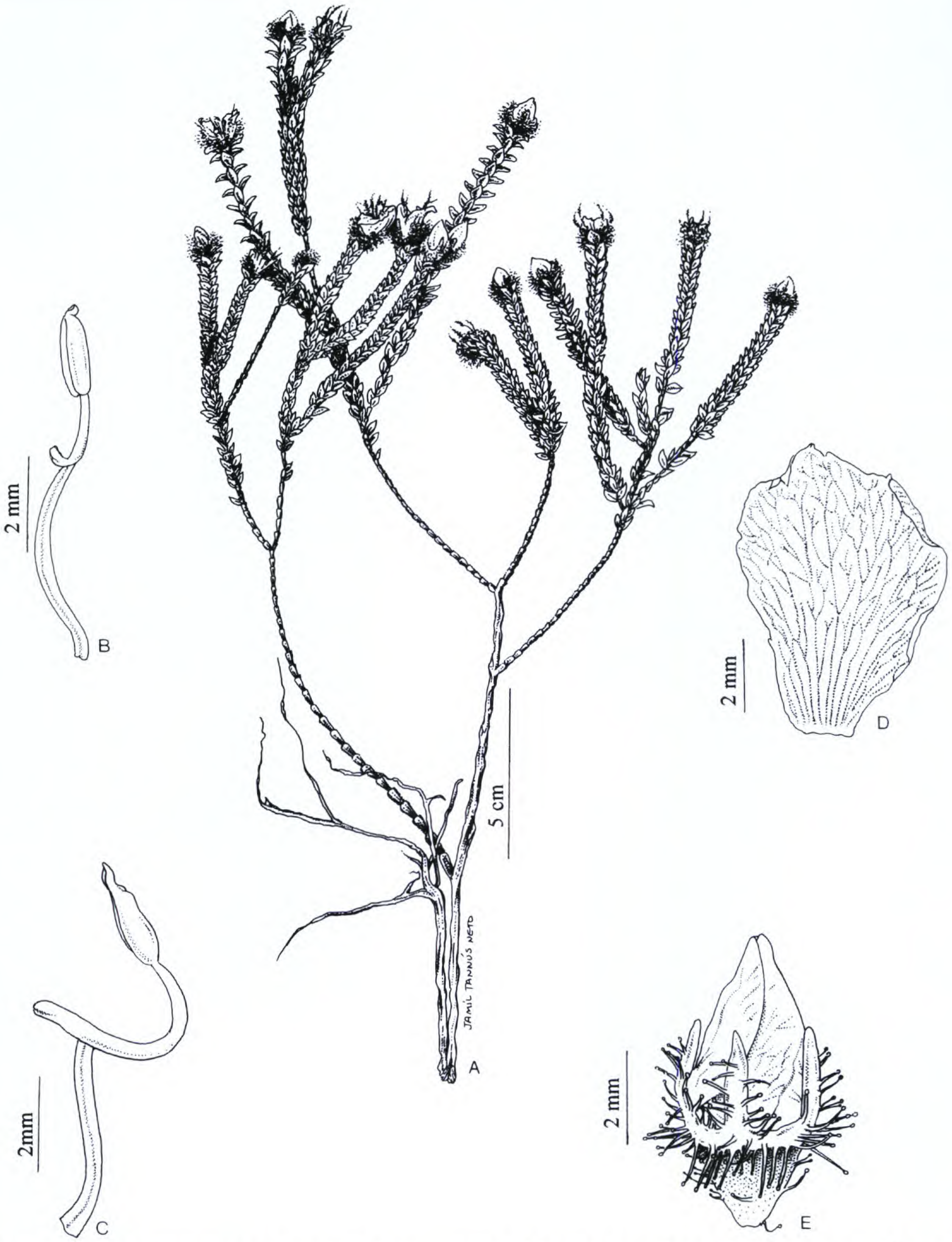

Figure 1. *Microlicia obtusifolia* Cogniaux ex R. Romero. —A. Habit. —B. Lateral view of small stamen. —C. Lateral view of large stamen. —D. Petal. —E. Bud, hypanthium, and calyx lobes. Drawn from the holotype (*Duarte & Barroso 7858*).

tusifolia from *M. pusilla*. The latter has ovate to ovate-lanceolate leaves with an acute apex and rounded base with only one central vein. In *M. obtusifolia*, the leaves are larger (4–7 × 2–4 mm) than in *M pusilla* (2–4 × 1–2 mm).

This species was recognized by A. Cogniaux based on Glaziou collections (*Glaziou 19206* as *Microlicia obtusifolia* and *Glaziou 19207* as *Microlicia obtusifolia* var. *microphylla*), but these names were never published by him. Later Glaziou (1908) effectively published Cogniaux's name *Microlicia obtusifolia* and the variety *microphylla*, but invalidly, in his list for central Brazil. This publication by Glaziou was not valid due to the absence of a diagnosis, referring to Article 32 of the *International Code of Botanical Nomenclature* (Greuter et al., 2000). After the author's examination of Glaziou's collections (*Glaziou 19206, 19207* cited herein as paratypes) in BM, K, P, and W, it is quite clear that Cogniaux recognized this new species based on material at Brussels, although these sheets were not seen by the author. Glaziou further wrote in sched. on *Glaziou 19206* "*Microlicia obtusifolia* Cogn. ined. ex numero" (seen on sheets at K, P, R), and on *Glaziou 19207* the name "*Microlicia obtusifolia* Cogn." (as seen on sheets at BM, K, P, R).

Paratypes. BRAZIL. **Minas Gerais:** Diamantina, Serra dos Crystaes, 4 Apr. 1892, *Glaziou 19206* (K, P, R); Serra dos Crystaes a Diamantina, 4 Apr. 1892, *Glaziou 19207* (BM, K, P, R, US); Serra dos Cristaes, 4 Apr. 1892, *Schwacke 7866* (W); Diamantina, Sentinela, 8 Dec. 1937, *Mello Barreto 9623* (HUFU); ca. 12 km SW of Diamantina, 18 Jan. 1969, *H. S. Irwin et al. 22161* (B, P); ca. 12 km SW of Diamantina, rocky slopes with soil-filled pockets and crevices, 19 Jan. 1969, *H. S. Irwin et al. 22198* (NY, US); Biribiri, 27 Nov. 1992, *J. R. Stehmann s.n.* (BHCB); estrada Diamantina–Gouveia, ca. 12 km SW de Diamantina, 30 Mar. 2001, *R. Romero & J. N. Nakajima 6068* (HUFU, MO); Santa Luzia do Rio das Velhas, *Schwacke s.n.* (RB), *s.n.* (OUPR).

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Polianthes multicolor (Agavaceae), Especie Nueva de Guanajuato, México

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RESUMEN. Se describe e ilustra *Polianthes multicolor*, una especie nueva del estado de Guanajuato, México. Esta especie muestra similitudes con *Polianthes geminiflora* (Lexarza) Rose var. *geminiflora* y *Polianthes geminiflora* var. *clivicola* McVaugh. Difiere de ambas variedades por la forma del tubo periántico, los lóbulos patentes, la presencia de células buliformes y la ausencia de taninos en el mesofilo.

ABSTRACT. *Polianthes multicolor* a new species from Guanajuato, Mexico, is described and illustrated. This species is related to *Polianthes geminiflora* (Lexarza) Rose var. *geminiflora* and *Polianthes geminiflora* var. *clivicola* McVaugh; it differs from them in the shape of the perianth tube, spreading lobes, the presence of bulliform cells in the foliar epidermis, and the absence of tannins in the mesophyll.

Key words: Agavaceae, Mexico, *Polianthes*.

De acuerdo con la clasificación de Dahlgren et al. (1985) el género *Polianthes* pertenece a la familia Agavaceae; es endémico de México y se distribuye desde el suroeste del estado de Chihuahua y sur de Tamaulipas, en el norte, hasta el noroeste de Oaxaca, en el sur. Ha sido poco estudiado desde el punto de vista taxonómico y su representación, tanto en los herbarios nacionales como extranjeros, es muy pobre. En 1903, J. N. Rose realizó la única revisión del género, reconociendo 12 especies. A partir de este tiempo, se intensificó la propuesta de nuevas combinaciones y descripciones, las cuales crearon mucha confusión en la delimitación de sus especies y de los géneros próximos. A mediados de 1994 se inició la revisión sistemática del género; las observaciones generadas durante este estudio, incluidas las investigaciones anatómicas y la exploración botánica en toda su área de distribución geográfica, revelaron la existencia de la especie nueva que a continuación se describe.

Polianthes multicolor E. Solano & Dávila, sp. nov. TIPO: México. Guanajuato: municipio de San Luis de la Paz, sobre el camino viejo de terracería a Xichú, en la base del cerro Garbanzo, bosque de encino, alt. 2490 m, 16 ago. 1996, *E. Solano C. & C. Correa D. 871* (holótipo, MEXU; isótipos, CHAPA, ENCB, FEZA, MO, NY, RSA, UAMI, US). Figura 1.

Herba perennis. Folia epidermide cellulas bulliformes continente, mesophylli cellulis acido tannico carentibus. Flos subhypocraterimorphis, perianthii tubo intra plerumque luteo, interdum albo, lobulis patentibus, colore variabilibus, excremeis vel subalbidis, exroseis rubescentibus, roseis albolineatis, vitellinis, vel luteo-aurantiacis.

Hierba perenne, 28–74 cm de alto, bulbo (1.5–)2.7–4.0(–4.5) cm de largo, 1.0–1.5(–2.0) cm de diámetro; hojas 2–4(–6) por roseta, (7–)11–30 (–37) cm de largo, 1.0–4.5(–9.0) mm de ancho, lineares, margen papiloso; células buliformes en la epidermis foliar; células del mesofilo sin taninos. Brácteas de la base del pedúnculo floral 4–18(–21) cm de largo, 1.4–4.3(–7.0) mm de ancho, lineares; inflorescencia un racimo laxo de (28–)33–64 cm de longitud, 3–9(–16) nudos fértiles. Brácteas florales ovadas o lanceoladas, con el ápice generalmente acuminado a largamente acuminado, a veces agudo; bractéolas dos por flor, lanceoladas o lineares, con el ápice agudo a veces acuminado; ambas disminuyen en tamaño desde la base de la inflorescencia hacia el ápice. Flores de 18–28 mm de largo, 1.4–3.6(–4.2) mm de ancho en la base de los lóbulos; casi hipocrateriformes, pedicelos (3.5–)4.4–16 mm de largo; lóbulos de 2–4 mm de largo, 1.1–3.3(–

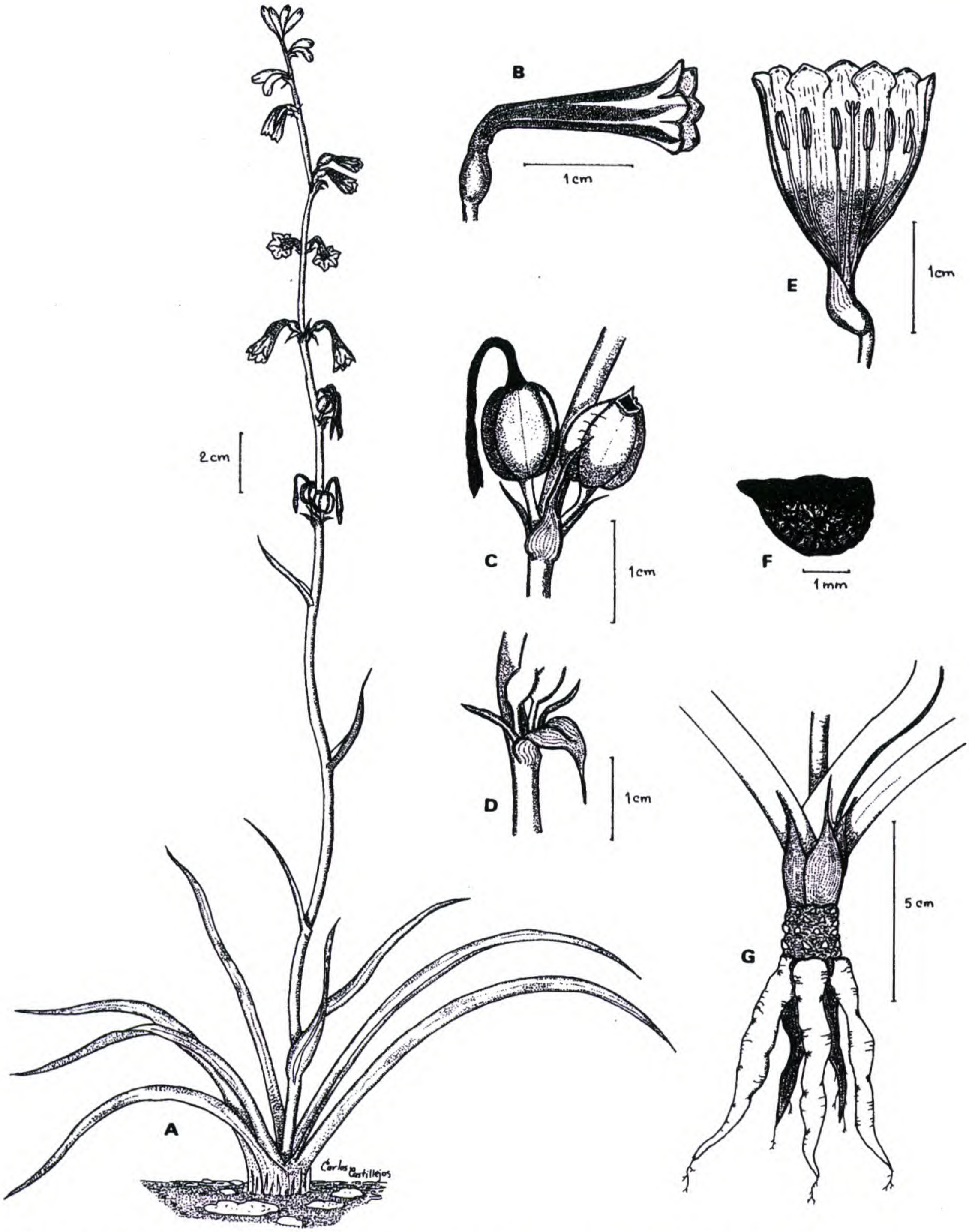

Figura 1. *Polianthes multicolor* E. Solano & Dávila. —A. Planta con inflorescencia. —B. Flor completa. —C. Fruto. —D. Bráctea y bractéolas. —E. Flor abierta. —F. Semilla. —G. Bulbo y cormo con raíces contráctiles. Ilustración basada en *E. Solano C. & C. Correa D. 871* y realizada por C. Castillejos Cruz.

3.6) mm de ancho, ovados o elípticos, extendidos, con el ápice obtuso o redondeado, los internos similares a los externos, color variable, desde crema a casi blanco, rosado con rayas blancas, rosado amarillento, rosado a casi rojo o anaranjado amarillento; interior del tubo completamente amarillo, a veces blanco, con los lóbulos a veces amarillos; estambres inclusos, filamentos 1.0–1.7 cm de largo,

Tabla 1. Diferencias morfológicas entre *Polianthes multicolor* especie nueva y *P. geminiflora*.

Carácter	*P. geminiflora*	*P. multicolor*
Diámetro del bulbo	1.5–5.0 cm	1.0–1.5 cm
Borde de la hoja	Papiloso, liso	Papiloso
Ancho de la hoja	2–30 mm	1.0–4.5 mm
Ancho de la bráctea basal	2–10 mm	1.4–4.3 mm
Número de nudos fértiles	2–12	3–9
Forma de las flores y disposición	Tubulares, colgantes	Casí hipocrateriformes, horizontales
Color de las flores	Anaranjado, coral, rojo	Crema a casi blancas, rosadas, rosadas con rayas blancas, rosadas-amarillentas, rosadas-casi rojas, anaranjado-amarillentas
Largo del lóbulo floral externo	2–3 mm	2–4 mm
Lóbulos del tubo del perianto	Erectos	Patentes
Células buliformes en la epidermis	Ausentes	Presentes
Taninos en las células del mesofilo	Presentes	Ausentes

blancos o amarillos; insertos entre 3 y 6 mm por arriba del ápice del ovario; anteras 3.9–5.4(–6.0) mm de largo, oblongas, amarillas; estilo (1.1–)1.2–1.7 cm de largo, blanco o amarillo. Fruto semiesférico de 1.0–1.3(–2.4) cm de largo, 8–10 mm de diámetro; semillas (2.1–)3.0–3.9 mm de largo, 2.2–2.9 mm de ancho, color negro, semicirculares.

Hábitat. *Polianthes multicolor* se desarrolla entre los 2200–2490 m, en bosques de encino, encino-pino, pino y pastizales, en suelos de color pardo a negro con textura arenosa.

Polianthes multicolor se caracteriza por presentar las flores casi hipocrateriformes con una gran variedad de coloraciones. El interior del tubo es completamente amarillo, a veces blanco, y los lóbulos son patentes, a veces amarillos, sobre todo, en su cara interna. Además, los estudios anatómicos señalan la presencia de células buliformes en la epidermis foliar y la ausencia de taninos en las células del mesofilo (Solano, 2000). Las células buliformes también caracterizan a *P. geminiflora*, *P. graminifolia*, *P. platyphylla*, *P. longiflora* y *P. sessiliflora*, cinco de las 14 especies reconocidas por Solano (2000), todas ellas con hojas más o menos conduplicadas en función de la aridez. Mientras que, los taninos están presentes en *P. densiflora*, *P. graminifolia*, *P. nelsonii* y *P. sessiliflora*. *Polianthes multicolor* morfológicamente se relaciona con *P. geminiflora* (Lexarza) Rose, de la que se distingue por las características mostradas en la Tabla 1.

Polianthes multicolor es la especie del género que muestra la mayor variabilidad en el color de las flores. Este carácter se presenta únicamente en este nuevo taxon. Es probable que en el pasado reciente se haya producido una fecundación cruzada entre *P. geminiflora* y *P. montana* o *P. sessiliflora*. *Polianthes geminiflora* tiene flores colgantes, rojas o anaranjadas, no aromáticas, polinizadas durante el día por colibríes; *P. montana* y *P. sessiliflora*, presentan flores blancas, aromáticas, horizontales, polinizadas muy probablemente por polillas nocturnas. Ocasionalmente, un colibrí o una polilla, pudieron haber realizado fecundación cruzada entre ambas especies, dando origen a *P. multicolor*. Actualmente, no se ha observado que especies de flores rojas y blancas ocurran simpátricamente.

La especie aquí descrita se localiza en la sierra de Guanajuato, sobre el Eje Neovolcánico Transversal y Altiplano Mexicano, en los municipios de Guanajuato, Ciudad Manuel Doblado, Ocampo, San José Iturbide, San Luis de la Paz, San Miguel de Allende, Victoria y Xichú. Muy probablemente las poblaciones referidas por Howard (1986) situadas en la región montañosa al norte de Dolores Hidalgo, pertenezcan a esta nueva especie. Este autor indica que son muy diferentes de aquellas encontradas más al sur de México; hace hincapié en la variabilidad de colores presentes y que de alguna manera se relacionan con *Polianthes geminiflora*, pero que obviamente no pueden ser consideradas como pertenecientes a esta última especie.

Polianthes multicolor únicamente es conocida del área antes mencionada. *Polianthes geminiflora* var. *geminiflora* se distribuye desde el estado de Nayarit a Tlaxcala y Puebla; *P. geminiflora* var. *clivicola* McVaugh es endémica de Jalisco y Michoacán.

El epíteto específico hace referencia a la gran variedad de colores que presentan las flores.

Paratipos. MÉXICO. **Guanajuato:** Manuel Doblado,

41 km NE de León, cerca de Cañada Grande, 14 jun. 1987, *J. Rzedowski 43753* (IEB); Ocampo, 10 km S de Ibarra, sobre la carretera a León, 3 ago. 1991, *J. Rzedowski 50794* (IEB); San José Iturbide, cerro Rincón del Pájaro, 2 km E de San Diego, 24 jul. 2001, *C. Castillejos C. et al. 1120* (FEZA); 2 km NW de la Torna, 13 jul. 2002, *J. Gutiérrez G. 326* (FEZA); San Luis de la Paz, 34–35 mi. E of San Luis de la Paz toward Xichú, 1 ago. 1958, *R. M. Straw & M. Forma 1481* (MICH); San Miguel de Allende, Cañada de la Virgen, 8 ago. 1978, *J. Kishler 303* (MEXU); antenas de microondas, camino a Palo Huérfano, 16 ago. 1987, *A. Mora B. 778* (IEB); antes de llegar a San José, 15 ago. 1996, *E. Solano C. & C. Correa D. 869* (FEZA); 2 km E de la carr. Juventino Rosas–Guanajuato, 3 ago. 1997, *E. Solano C. & C. Correa D. 1104* (FEZA); camino de terracería al Viejo Simatario, 3 ago. 1997, *E. Solano C. & C. Correa D. 1105* (FEZA); 14 km NW de Juventino Rosas, 3 ago. 1997, *E. Solano C. & C. Correa D. 1106* (FEZA); Victoria, 50 km E de San Luis de la Paz, 4 ago. 1997, *E. Solano C. et al. 1109* (FEZA); 51 km E de San Luis de la Paz, 4 ago. 1997, *E. Solano C. et al. 1110* (FEZA); Victoria, El Milagro, 4 ago. 1997, *E. Solano C. et al. 1112* (FEZA); Milpillas del Pito, 7 jun. 1989, *E. Ventura & E. López 6756* (MEXU); Xichú, El Ocotero, 4 ago. 1997, *E. Solano C. et al. 1111* (FEZA); betw. Valenciana and Santa Rosa, km 11–12 road from Guanajuato Dolores Hidalgo, 29 ago. 1948, *H. E. Moore Jr. & C. E. Wood Jr. 4798* (MICH); 27 km N de Juventino Rosas, 12 jul. 1948, *J. Rzedowski 43611* (ENCB).

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Cypringlea, a New Genus of Cyperaceae from Mexico

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Abstract. Studies of the floral morphology of the Mexican endemics *Scirpus analecta* Beetle and *Scirpus coahuilensis* Svenson, including embryo morphology and scanning electron microscopy (SEM) studies of the achenes, achene pericarp, and perianth bristles, indicate that like *Scirpus* L., they are members of the tribe *Scirpeae* Kunth ex Dumortier. However, they were found to possess a *Carex*-type embryo that is characteristic of *Trichophorum* Persoon. Because of differences in habitat, leaf blade development and morphology, inflorescence morphology, and the possession of rudimentary perianth bristles, they are shown to be better circumscribed in a genus of their own, *Cypringlea* M. T. Strong. *Cypringlea* is described, and the combinations *C. analecta* (Beetle) M. T. Strong and *C. coahuilensis* (Svenson) M. T. Strong are validated. Drawings of the embryos, SEM images of the achenes, achene pericarp, and perianth bristles, and photographic images of herbarium type specimens of the plants are provided, and the relationships of *Cypringlea* to *Scirpus* and *Trichophorum* are discussed.

Key words: Cyperaceae, Cyperoideae, *Cypringlea*, Mexico, Scirpeae, *Scirpus*, *Trichophorum*.

Since the seminal classification of embryos of the Cyperoideae (Cyperaceae) by Van der Veken (1965), from which much of the present-day relationships of species in that subfamily have been based, there still remain species described in the heterogeneous *Scirpus* L. that are discordant with today's circumscription of it, in which *S. sylvaticus* L. has been conserved as the type (Wilson, 1989). Two rare and little-known Mexican endemics, *S. analecta* Beetle and *S. coahuilensis* Svenson, members of the tribe *Scirpeae* Kunth ex Dumortier, are examples of species that are still unclassified.

Methods

Achenes were soaked in a mixture of distilled water and antibacterial detergent for 24 hours. The pericarp was then split on the two lateral costula and peeled away. Embryos were teased out of the bottom of the mass of endosperm and placed in a clearing solution of lactophenol (Parker, 1976) for 24 to 96 hours. They were then mounted in Hoyer's solution and the features drawn using a camera lucida. For the scanning electron microscopy studies, achenes were mounted onto 12 mm SPI aluminum luster mounts using double-sided tape tabs. These were then carbon-coated and observed using a digital Leica Scanning Electron Microscope.

Embryos

The two species of *Cypringlea* have embryos of the *Carex*-type (Fig. 1) following Van der Veken (1965) and Goetghebeur (1986). The *Carex*-type embryo is circumscribed as top-shaped, has a basal radicle, and the orientation of the germination pore, relative to the first leaf, is perpendicular. The embryo of *C. analecta* measures 0.34–0.39 × 0.24–0.29 mm and that of *C. coahuilensis* is 0.47–0.52 × 0.33–0.39 mm.

Description of the Genus

Cypringlea M. T. Strong, gen. nov. TYPE: *Cypringlea analecta* (Beetle) M. T. Strong ≡ *Scirpus analecta* Beetle.

Inter species tribus *Scirpeae*, *Trichophoro* affine, differt laminis foliis benevolutis, apicibus attenuatis triquetris; inflorescentia anthelata; rostro achenio nullo marginato ab rima humili in apice achenio; setis gerentibus hamis antrorsis rudimentariis distalibus quibus apicibus obtusis vel rotundatis, deminutis ad protuberationibus minutis proximalibus.

Rhizomatous perennial glabrous herbs; roots coarse, to 1 mm thick. Culms 30–70 cm tall, triquetrous or obtusely trigonous in cross section. Leaves basal or several lower cauline; sheaths very short, herbaceous to thickly herbaceous, auriculate at apex in one species, the inner band membranous with a truncate to deeply U- or V-shaped orifice; ligule a narrow band of thickened smooth or lacerate tissue at adaxial junction of sheath and blade; blades herbaceous, linear or linear-filiform, flattened to V-shaped or folded or wiry and triangular-channeled, the margins and abaxial midvein (when present) antrorsely scabrous. Inflores-

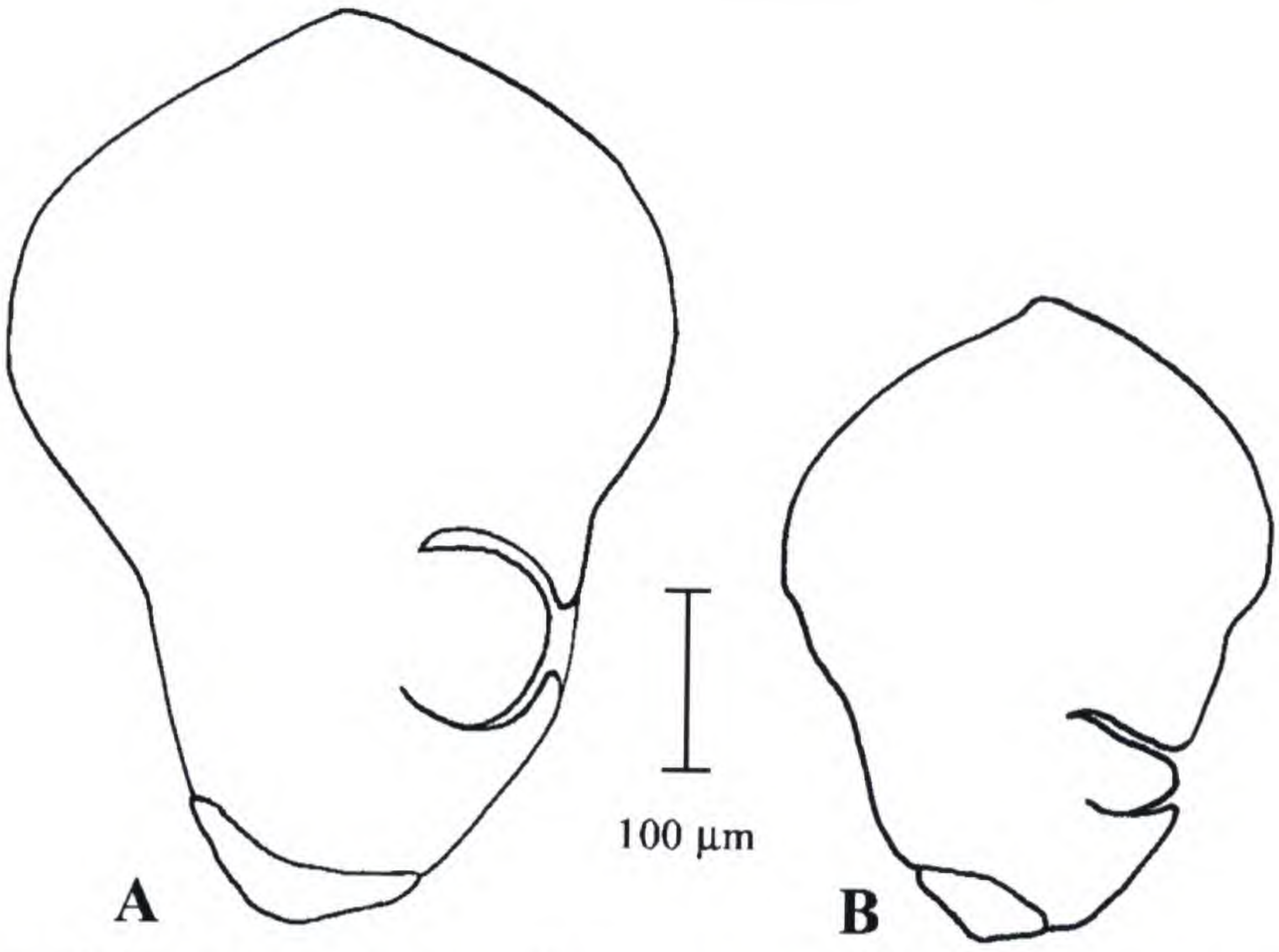

Figure 1. Embryos of *Cypringlea*. —A. *C. coahuilensis* (Svenson) M. T. Strong, from *Johnston 8763* (LL). —B. *C. analecta* (Beetle) M. T. Strong, from *Pringle 3175* (US).

cence a compound umbel-like corymb or a single fascicle or cymose panicle of 2–3 subcontiguous fascicles of spikelets at the summit of the culm; involucral bracts 2–5, leaf-like or linear-setaceous, the lowermost 1–2 elongate and often exceeding the inflorescence; rays ascending or curving with age; spikelets ovoid-ellipsoid to ellipsoid or ellipsoid-obovoid when immature, 5–10 × 2–3 mm, each subtended by a 2-nerved prophyll at base, the scales often spreading with maturing achenes; scales ovate to widely ovate or ovate-elliptic to oblong-ovate, obtuse to rounded or broadly rounded in cross section, thinly herbaceous to submembranous, semi-glossy, midcosta distinct, mucronate at apex, lateral nerves indistinct; fertile scales 10–30 per spikelet; sterile scales 0–4 at base of spikelet. Flowers bisexual, loosely spirally arranged or sometimes irregularly distichous proximally; stamens 3, the anthers basifixed, thecae parallel, longitudinally dehiscent; style 3-branched. Achene obscurely trigonous to plano-convex, obovate to elliptic-obovate or broadly obovate, 1.5–2 × 0.8–1.5 mm, rounded to subrounded or obtuse at apex, cuneate at base, adaxial side often slightly concave, margins indistinctly costate or distinctly so proximally, pale brown, lighter than the sides, epidermis very finely cellular-reticulate when immature, papillose at maturity, stramineous to light brown when immature, dark brown at maturity; epidermal cells 6-sided, isodiametric, each with an apical nodule that is well-developed and buttressed at maturity, the walls essentially straight when immature, forming a wavy configuration at maturity; style base essentially absent, at most a depressed-pyramidal remnant of tissue or a low, 3-sided rim at achene apex, 0.1 mm long or less, 0.1–0.2 mm wide, brown; bristles 2–4, subulate, reddish, often represented only by short rudiments that rarely reach to middle of achene, the longer often with antrorse to divergent, blunt- or round-tipped barbs distally, these often reduced to small nubs proximally; embryo of the *Carex*-type.

Distribution. The genus contains two species endemic to Mexico.

Etymology. *Cypringlea* is named in honor of botanical explorer Cyrus Guernsey Pringle (1838–1911), the first collector of *C. analecta*, who collected plants in Mexico between the years ± 1882 and 1907.

Key to the Genera of the Tribe Scirpeae

1. Perianth of scale-like tepals, persistent on the rachilla . . . . . *Oreobolopsis* T. Koyama & Guaglianone
1′. Perianth of bristles, often persistent at base of achene 2
2(1). Bristles 10 to many, greatly elongating after anthesis and often forming white cottony masses around spikelets . . . . . *Eriophorum* L.
2′. Bristles 3 to 6 or rudimentary, short or reduced, rarely elongating and forming white or brown wooly masses around spikelets 3
3(2). Bristles with spine-like, retrorsely set barbs 4

3′. Bristles with antrorsely or divergently set hairs or blunt barbs, rarely smooth, sometimes rudimentary 6
4(3). Inflorescence compound, anthelate with elongate rays; spikelets numerous . . . . . *Scirpus* L.
4′. Inflorescence a simple head of 1 to few spikelets at the summit of the culm 5
5(4). Inflorescence pseudolateral; style 2-branched . . . . . *Amphiscirpus* Oteng-Yeboah
5′. Inflorescence capitate; style 3-branched . . . . . *Phylloscirpus* C. B. Clarke
6(3). Leaf blades reduced, often with rounded or thickened tips; inflorescence typically of a single spikelet; achenes beaked or shortly so; bristles well-developed . . . . . *Trichophorum* Persoon
6′. Leaf blades well-developed, attenuate to triquetrous apex; inflorescences anthelate or paniculate; achenes unbeaked; bristles rudimentary . . . . . *Cypringlea*

KEY TO THE SPECIES OF *CYPRINGLEA*

1. Leaf blades linear, (2–)3–7.2 mm wide, flattened distally, often V-shaped or folded proximally, essentially straight, slightly curving only toward apex; inflorescence a compound, umbel-like corymb, 3.5–11 × 2–7 cm, the spikelets in small fascicles or sometimes solitary at tips of shorter secondary rays . . . . . 1. *C. analecta*
1′. Leaf blades linear-filiform, wiry, 0.3–0.8 mm wide, triangular-channeled, wavy and curling; inflorescence a single dense fascicle or cymose panicle of 2–3 subcontiguous fascicles of spikelets, 1–3 × 1–2 cm . . . . . 2. *C. coahuilensis*

DESCRIPTION OF THE SPECIES

1. Cypringlea analecta (Beetle) M. T. Strong, comb. nov. Basionym: *Scirpus analecta* Beetle, Brittonia 5(2): 148. 1944 (as "analecti"). TYPE: Mexico. San Luis Potosí: Minas de San Rafael, May 1911 (July 1911, UC #157273), *C. A. Purpus 5454* (holotype, NY; isotypes, F, GH, MO, UC, US). Figures 2, 4.

Scirpus analecta var. *evadens* C. D. Adams, Ann. Missouri. Bot. Gard. 78: 254. 1991. Syn. nov. TYPE: Mexico. Chiapas: steep slope with *Quercus* and *Pinus*, 3 mi. S of Aguacatenango along road to Pinola Las Rosas, Municipio of Venustiano Carranza, 5600 ft., 25 June 1965, *D. E. Breedlove 10570* (holotype, F #1679132).

Culms solitary, often forming basal offshoots, 30–70 cm tall, 1–2.3 mm wide, erect to ascending, slender, triquetrous, firm but flexuous, coarsely ribbed, green to pale green, the angles finely and closely antrorsely scabrous, often smooth proximally, the sheath-clad bases (4–)7–12 mm wide. Leaves 5–14, 16–80 cm long, ascending, approximate at or just above the base, often appearing subverticillate, ecauline; sheaths short, herbaceous, finely and distinctly veined, light green or often stramineous, old sheath bases brown, often persistent and becoming fibrillose, the inner band with a truncate to deeply U-shaped orifice; ligule a narrow, thickened band of tissue; blades linear, (2–)3–7.2 mm wide, flattened distally, often V-shaped or folded proximally, finely veined and green both adaxially and abaxially, margins and abaxial midvein finely and closely antrorsely scabrous, long-attenuate to triquetrous apex. Inflorescence a compound, umbel-like corymb, terminal, 3.5–11 × 2–7 cm; involucral bracts several, the lowermost 1–2 leaf-like, elongated and often exceeding the inflorescence, the uppermost linear-setaceous; rays ascending to curving with age, flexuous, flattened or compressed-trigonous, antrorsely scabrous on margins distally, smooth proximally, the spikelets often fascicled or sometimes solitary at tips of shorter secondary rays; spikelets 13–90 per inflorescence, ovoid-ellipsoid or sometimes ellipsoid-obovoid when immature, 5–7(–8) × 2–3 mm, with spreading scales, cuneate at base, acuminate at apex; scales broadly rounded in cross section, dorsally truncate or slightly furrowed longitudinally along midcosta, thinly herbaceous, light yellow-brown to yellow-brown, sometimes with brown sides, margins narrowly scarious proximally, midcosta 3-nerved, light green, thickening distally, prolonged beyond the obtuse apex as a short mucro, lateral nerves indistinct; fertile scales 10–20, ovate-elliptic to oblong-ovate, 1.8–3 × 1–1.3 mm; sterile scales 2–4 at base (excluding 2-nerved prophyll), ovate, shorter than the fertile. Flowers loosely spirally arranged or appearing 4-ranked, the rachilla slightly elongated between the flowers; anthers 1.5–2 mm long, apiculate at apex, rounded with minute papillae at base; style branches reddish, scaly-fimbriate, equaling to 1/3 longer than unbranched portion. Achene obovate to elliptic-obovate, 1.5–1.8 × 0.8–1.1 mm, rounded at apex, margins sometimes distinctly costate proximally, indistinctly so distally.

Distribution. Endemic to Mexico. Occurs on the western side of the Sierra Madre Oriental in the states of San Luis Potosí and Hidalgo, south to Puebla state in the Cerro de Paxtle, and southeast to a disjunct population in the Sierra Madre de Chiapas in Chiapas state.

Etymology. "Analecta" or "analects" is a plural noun sometimes used in titles meaning extracts or collections, typically from a particular classical author. It also has a slightly pejorative sense of

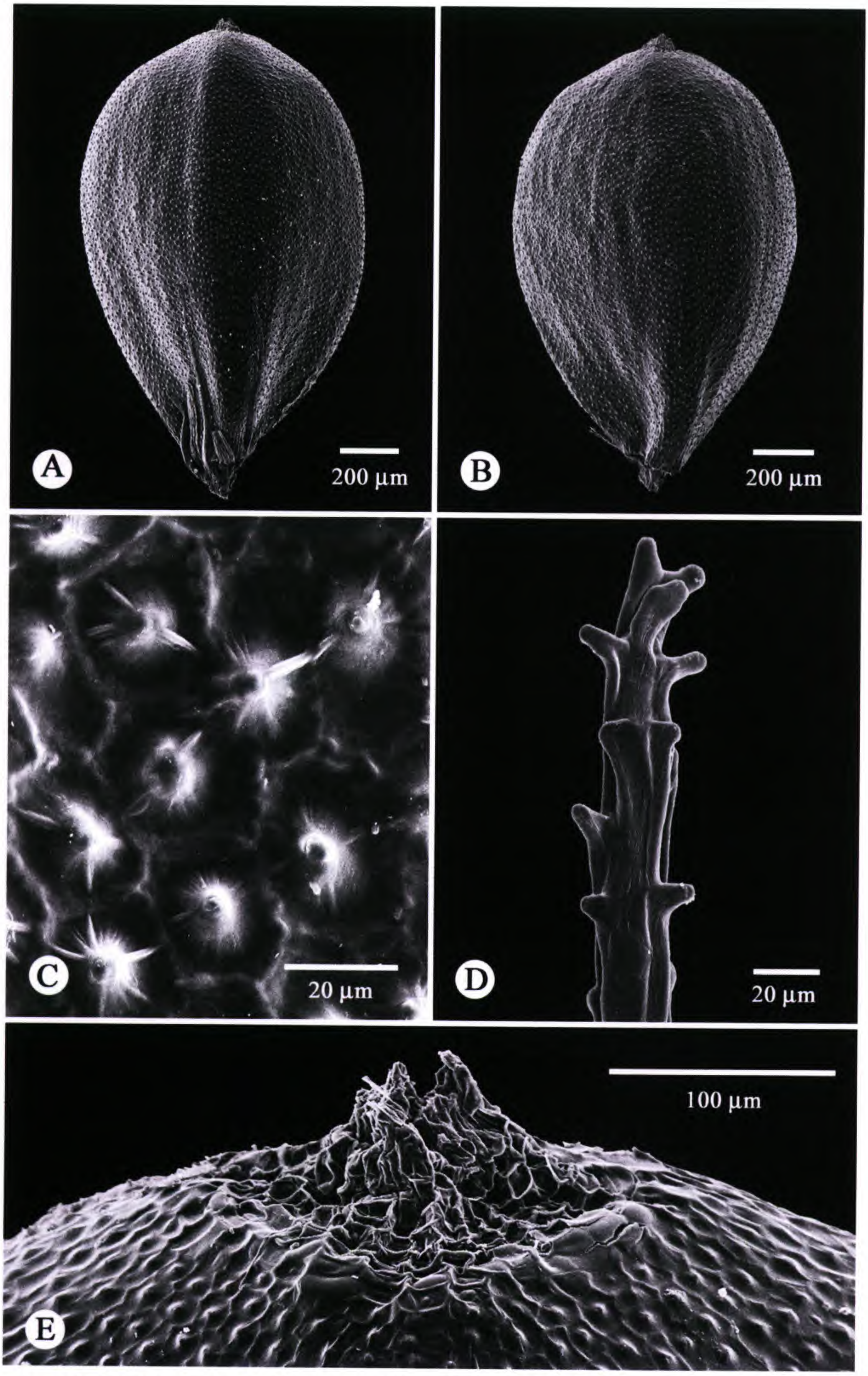

Figure 2. Achenes of *Cypringlea analecta* (Beetle) M. T. Strong. —A, B. Achenes. —C. Detail of epidermal cells. —D. Detail of distal end of bristle. —E. Apex showing detail of style base. From *Pringle 3175* (US).

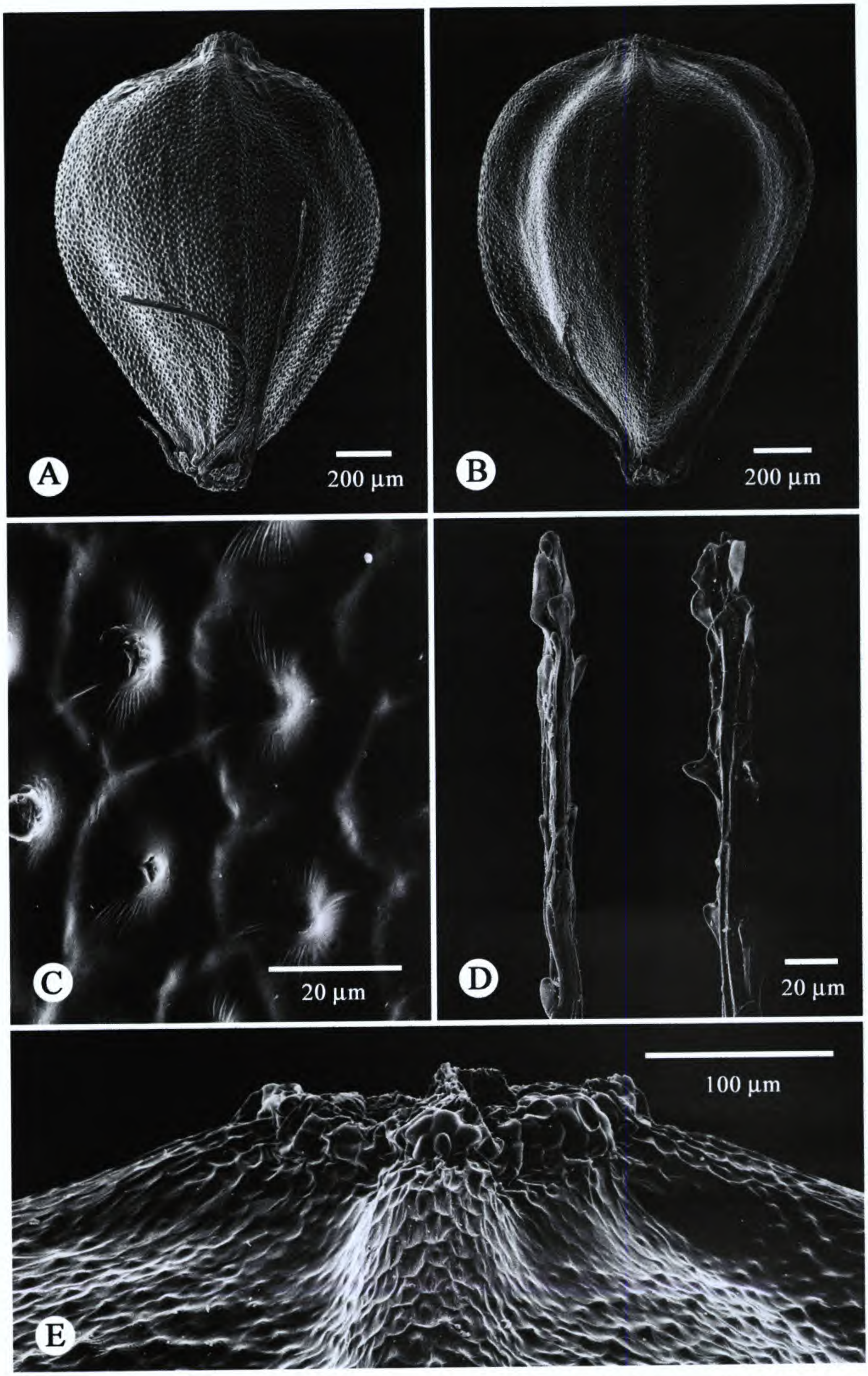

Figure 3. Achenes of *Cypringlea coahuilensis* (Svenson) M. T. Strong. —A, B. Achenes. —C. Detail of epidermal cells. —D. Detail of distal ends of bristles. —E. Apex showing detail of style base. From *Johnston 8763* (LL).

Figure 4. Herbarium type specimen, *Purpus 5454* (UC), isotype of *Cypringlea analecta* (Beetle) M. T. Strong.

"crumbs" or "leftovers." There seems to be no justification for retaining "analecti" (as originally published by Beetle), and the usual form analecta (noun in nominative plural) is here restored.

Cypringlea analecta was first named *Scirpus potosinus* by Britton (1892: 77) in a checklist of North American Cyperaceae. It was based on a Pringle collection (*3175*) from San Luis Potosí, Mexico. Britton gave the author as C. B. Clarke and cited it as *ined.* It was later listed by Clarke (1908: 89) in a manuscript published after his death, as *Scirpus potosiensis* C. B. Clarke, citing the earlier reference of Britton. Beetle (1944), noting that both these proposed names were *nomina nuda,* proposed the name *Scirpus analecti* and designated *Purpus 5454* as the holotype. Beetle also indicated that two other specimens he did not see belonged to this species, *Parry & Palmer 905* and *Arsène 2636,* brought to his attention by Hugh O'Neill, curator of the Langlois Herbarium, Catholic University (CU). However, these two specimens (both at US) belong to another species, *Karinia mexicana* (Britton) Reznicek & McVaugh. *Cypringlea analecta* has continued to be treated as a species of *Scirpus,* most recently by Adams (1994) in *Flora Mesoamericana* and Espejo Serna and López Ferrari (1997).

I have found no taxonomic significance to the inflorescence of *Scirpus analecta* var. *evadens* C. D. Adams in which the spikelets are solitary at ray tips. The specimen *Purpus 2889* (GH, US), from Puebla, is intermediate between the fascicled spikelets of the type material and that of *S.* var. *evadens* in having both solitary and fascicled spikelets at ray tips.

Representative specimens. MEXICO. **Hidalgo:** Jacala, July 1936, *E. Lyonnet 1318* (US). **Puebla:** vicinity of San Luis Tultitlanapa near Oaxaca, Cerro de Paxtle, rocky slopes, July 1907, *C. A. Purpus 2889* (GH, US). **San Luis Potosí:** moist banks of ravines, 15 Aug. 1890, *C. G. Pringle 3175* (F, ISC, MU, NY, US).

2. Cypringlea coahuilensis (Svenson) M. T. Strong, comb. nov. Basionym: *Scirpus coahuilensis* Svenson, J. Arnold Arbor. 25: 46. 1944. TYPE: Mexico. Western Coahuila: high limestone ridge with a forest of *Pinus pinceana,* abundant on rocky pine-clad slopes, SW end of the Sierra de la Fragua, 1–2 km N of Puerto Colorado, 2 Sep. 1941, *I. M. Johnston 8763* (holotype, GH not seen; isotype, TEX—2). Figures 3, 5.

Culms caespitose, 30–50 cm tall, 0.6–1 mm wide, ascending, obtusely trigonous, wiry, stiff, coarsely ribbed, smooth, pale green, the sheath-clad bases 5–10 mm wide. Leaves 3 to 5, basal and lower cauline, 10–35 cm long, ascending; sheaths herbaceous to thickly herbaceous proximally, membranous distally, coarsely veined, brown proximally, pale distally, the inner band with a deeply V-shaped orifice, auriculate at junction with blade; ligule a narrow band of lacerate tissue formed near base of the auricles; blades linear-filiform, wiry, 0.3–0.8 mm wide, triangular-channeled, wavy and curling, coarsely veined abaxially, smooth and V-channeled adaxially, pale green both adaxially and abaxially, margins closely antrorsely scabrous, triquetrous at apex. Inflorescence a single fascicle or a cymose panicle of 2–3 subcontiguous fascicles of spikelets at the summit of the culm, 1–3 × 1–2 cm; involucral bracts 2–3, linear-setaceous, 0.3–0.5 mm wide, the lowermost 1–2 greatly exceeding the inflorescence, 2–16 cm long; rays 1–2, short, ascending, flexuous, obtusely trigonous, crescentiform or subterete in cross section, smooth on margins; spikelets 3–9 per inflorescence, sublaterally compressed, ovate-elliptic to elliptic, 7–10 × 2–3 mm, acute to acuminate on both ends, the scales spreading with developing achenes; scales obtuse to rounded or broadly rounded in cross section, thinly herbaceous to submembranous, finely longitudinally cellular-striate, whitish- or stramineous-translucent, glabrous, margins broadly scarious, midcosta 3-nerved, pale green, prolonged beyond the obtuse to subrounded apex as a short mucro, lateral nerves indistinct; fertile scales 20–30, ovate to widely ovate or ovate-elliptic, 2.8–4 × 1.6–2.6 mm, the prophyll at base of spikelet well-developed, 2-nerved, about same size as fertile scales; sterile scales 0–1 at base (excluding 2-nerved prophyll), ovate, slightly shorter than the fertile. Flowers spirally arranged or sometimes subdistichous proximally on rachilla; anthers 1.7–2.2 mm long, rounded-apiculate with minute papillae at apex, short-sagittate with minute papillae at tips of lobes; style branches scaly-fimbriate, equaling to slightly shorter than unbranched portion of style. Achene obovate to broadly obovate, 1.6–2 × 1.1–1.5 mm, obtuse to subrounded at apex, margins indistinctly costate.

Distribution. Endemic to Mexico and known only from the type collection from a high limestone ridge in the southwestern end of the Sierra de la Fragua, western Coahuila.

Discussion

These two plants representing the new genus, first described as *Scirpus* L., and like *Scirpus* (today treated by many in a strict sense with the conserved

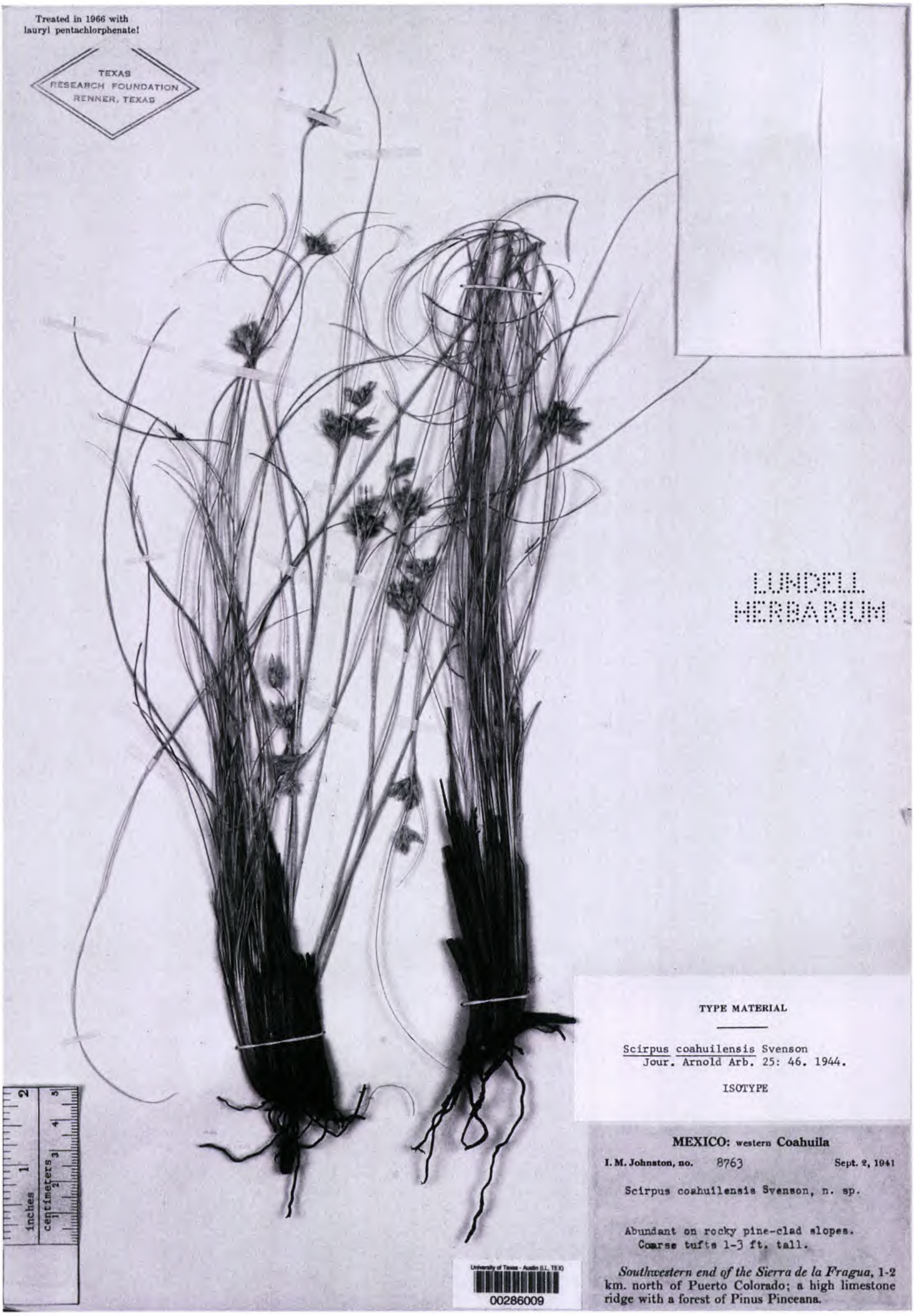

Figure 5. Herbarium type specimen, *Johnston 8763* (LL), isotype of *Cypringlea coahuilensis* (Svenson) M. T. Strong.

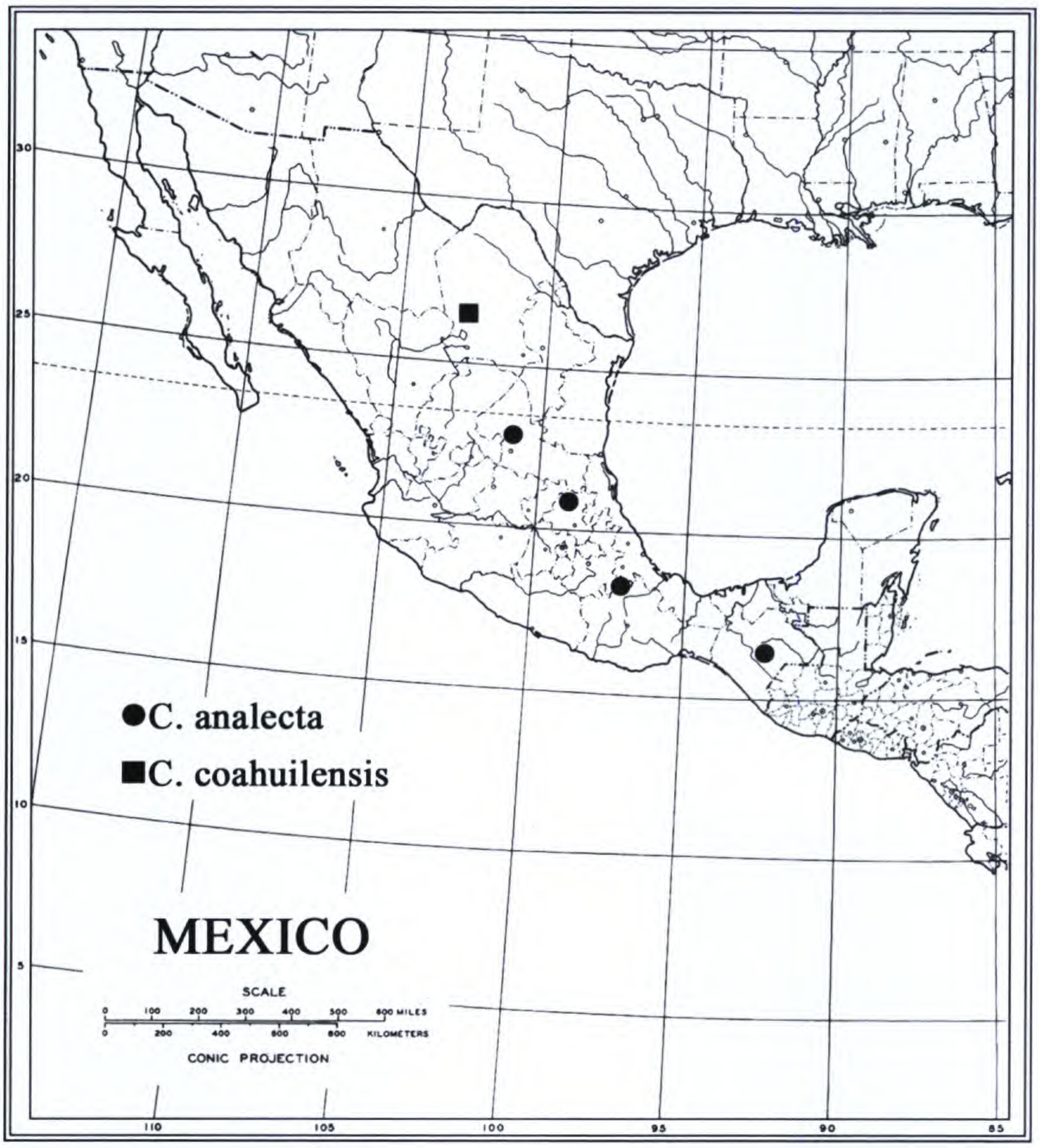

Figure 6. Distribution of *Cypringlea* in Mexico.

type, *Scirpus sylvaticus* L.), are members of the subfamily Cyperoideae Sussenguth following the most recent Cyperaceae classification of Goetghebeur (1998). The spirally arranged scales, embryo type, morphological and epidermal structure of the achene, and presence of persistent perianth bristles places them in the tribe Scirpeae Kunth ex Dumortier. *Scirpus* sensu stricto is characterized by having anthelate inflorescences, a *Fimbristylis*-type embryo, spikelets with all scales fertile, beaked achenes, and generally well-developed bristles with sharply tipped retrorse barbs. *Cypringlea* differs from it in having a *Carex*-type embryo (Fig. 1), 1 to 3 of the basal scales of the spikelet sterile (empty), unbeaked achenes, and rudimentary bristles that bear what appear to be blunt, rudimentary antrorsely or divergently set hairs or barbs at their tips (Figs. 2D, 3D).

The embryos of *Cypringlea* (Fig. 1) are of the *Carex*-type (Van der Veken, 1965; Goetghebeur, 1986) and are closest to its nearest relative, *Trichophorum* Persoon. *Cypringlea* differs from *Trichophorum* in having well-developed leaf blades and inflorescence bracts that are attenuate to a triquetrous apex; anthelate or paniculate inflorescences with capitate or fascicled spikelets; achenes (Figs. 2A, 2B, 2E; 3A, 3B, 3E) that are unbeaked, the disarticulation of the style occurring at the apex of the achene, bordered at most by a low, marginal rim (Figs. 2E, 3E); and poorly developed bristles (Figs. 2D, 3D) that bear rudimentary antrorse or divergent hairs or barbs distally that are blunt or rounded at their tips, or reduced to tiny nubs proximally. On the other hand, *Trichophorum* has reduced leaf blades and inflorescence bracts that are generally blunt and obtuse or rounded and often thickened at their apices; inflorescences of a single spikelet, rarely anthelate and never with spikelets fascicled or capitate; beaked or shortly beaked achenes, the style disarticulating at the apex of the beak; and well-developed perianth bristles that are

densely beset with antrorse or divergent fine hairs or barbs.

The achene pericarp cells of *Cypringlea* are isodiametric and 6-sided (Figs. 2C, 3C). When immature, they have a low central nodule and the walls are essentially non-wavy and markedly raised above the surface, forming a reticulation. At maturity, the walls are of a wavy configuration and each has one central conical body with well-developed buttresses between the walls and the body. In species of *Trichophorum*, the cell walls of the pericarp are generally non-wavy and lack buttresses between the walls and apical nodules (Schuyler, 1971).

Species of *Trichophorum* are holarctic and generally occur in wet or inundated alpine, tundra, or acidic bog habitats, rarely in damp or somewhat dry, mesic habitats in woodlands where, for example, the North American species *T. planifolium* (Sprengel) Palla occurs. *Cypringlea* species occur on dry, steep, rocky slopes and ravines, often on limestone substrate with pine and oak. The combination of a strikingly different habitat, well-developed leaf blades that are attenuate at their apices, anthelate or paniculate inflorescences, spikelets often fascicled or in capitate clusters, and rudimentary bristles, separates *Cypringlea* from *Trichophorum*.

Cypringlea is endemic to Mexico. It occurs from the Sierra de la Fragua (western side of the Sierra Madre Oriental mountain range) in western Coahuila state (type locality of *C. coahuilensis*) in the north, south to the western side of the Sierra Madre Oriental in the states of San Luis Potosí, Hidalgo, and Puebla (Cerro de Paxtle), and southeast to Chiapas state in the easternmost extent of the Sierra Madre de Chiapas (Fig. 6). Both species occur on steep, rocky slopes and ravines, often on limestone substrate with pine and oak.

Acknowledgments. I thank Dan Nicolson (US) for reviewing the manuscript and providing the information on the etymology of the epithet *analecta*; the National Museum of Natural History Scanning Electron Microscopy Lab for use of their facilities; and curators at F, GH, ISC, LL, UC, VT, and W for searching their collections and loaning specimens.

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Two New Winged Species of *Symbolanthus* (Gentianaceae: Helieae) from Colombia

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ABSTRACT. Two new Colombian species were identified in the Neotropical genus *Symbolanthus* (Gentianaceae: Helieae) during an ongoing revisionary study. *Symbolanthus pterocalyx* Struwe is characterized by its green to yellow corollas, strongly winged stems, and long-acuminate calyx lobes with a long, thin dorsal keel on each lobe. The other new species, *Symbolanthus tetrapterus* Struwe, also has strongly winged stems, but corollas variously colored in green, white, pink, to red-violet and calyx lobes rounded and non-keeled. Both species are endemic to small areas in the Andes of western Colombia. The western outlier Cerro del Torrá of the Cordillera Occidental in the province of Chocó (Colombia) is the only known locality of *Symbolanthus tetrapterus*. *Symbolanthus pterocalyx* occurs in high-elevation cloud forests, subpáramo, and páramo in a small area around Medellín in the province of Antioquia (Colombia).

RESUMEN. Se describen dos especies nuevas del genero neotropical *Symbolanthus* (Gentianaceae: Helieae). *Symbolanthus pterocalyx* Struwe se caracteriza por las corollas verdes o amarillas, los tallos fuertamente alados, y por los lóbulos del cáliz largos, acuminados y con una quilla dorsal larga y delgada sobre cada lóbulo. La otra especie nueva, *Symbolanthus tetrapterus* Struwe, tiene también tallos fuertemente alados y las corolas varían desde verdes o blancas hasta rosadas o rojo-violetas, pero los lóbulos del cáliz son redondos y no quillados. Las dos especies son endémicas de areas restringidas en los Andes occidentales de Colombia. *Symbolanthus tetrapterus* se ha registrado solamente en el Cerro del Torrá, saliente de la Cordillera Occidental en el departamento del Chocó (Colombia). *Symbolanthus pterocalyx* se encuentra en bosques nublados de elevaciones altas, subpáramos, y páramos cerca de Medellín, en el departamento de Antioquia (Colombia).

Key words: Colombia, Gentianaceae, Helieae, Neotropics, *Symbolanthus*.

Symbolanthus G. Don is one of the most colorful and large-flowered genera of tropical American Gentianaceae. It is a member of tribe Helieae, a group that also includes *Chelonanthus* (Grisebach) Gilg, *Irlbachia* Martius, *Macrocarpaea* (Grisebach) Gilg, and *Tachia* Aublet (Struwe et al., 2002). *Symbolanthus* has the broadly bilamellate stigmas, curved stamens, pollen in tetrads, slightly zygomorphic flowers, and woody habit that are characteristic of this tribe. Its position in the Helieae is also supported by molecular data from several sources.

The plants of *Symbolanthus* are shrubby, sometimes small trees, and less often herbaceous. The flowers are 4–10 cm long, and two main types of corollas occur in the genus. The first type are salver-shaped and brightly pink, red, or purple corollas, often with white nectar guides on the lobes. The second type is more broadly shaped, with corollas that are basically white, yellow, to green. In most recent Andean floristic treatments one polymorphic species, *Symbolanthus calygonus* (Ruiz & Pavón) Grisebach, has been recognized (e.g., Montúfar, 2000; Pringle, 1995). During the last decades, dozens of previously described species (e.g., Grisebach, 1849; Gilg, 1906) have been recognized as synonyms under *Symbolanthus calygonus* following an unpublished revision by Noor van Heusden (Utrecht University). For her revision, she annotated all investigated *Symbolanthus* herbarium material with the name *Symbolanthus calygonus* (except for two highly distinct and narrowly endemic species). In herbaria and Andean floras, this view has been followed until now. Such a broadly circumscribed *Symbolanthus calygonus* included widely diverse calyx and corolla morphology traits. Immediately apparent is the corolla color, which in *Symbolanthus calygonus* sensu lato varies from deep magenta and red through pink to white, yellow, and green. Using this broad circumscription, *Symbolanthus calygonus* also had a distribution that covered all of the Andes from Bolivia in the south to Costa Rica in the north.

Van Heusden included the handful of *Symbolanthus* species of the Guayana Highlands in her broadly circumscribed species concept, but this view has never been followed in floristic works of that area (cf. Maguire & Boom, 1989; Struwe et al., 1999). Similarly, the Central American material has been consistently treated as a distinct species, e.g., *Symbolanthus pulcherrimus* Gilg (Standley, 1938; Elias & Robyns, 1975).

An ongoing revision of *Symbolanthus* by the author reveals that *Symbolanthus calygonus* is a species that is restricted to the Huánuco region in Peru and is characterized by having a thick "hump-like" dorsal keel on each calyx lobe. This suggests that many Andean species face resurrection, e.g., *Symbolanthus daturoides* (Grisebach ex Hooker) Gilg, *S. magnificus* Gilg, and *S. vasculosus* (Grisebach) Gilg, all of which have distinct morphological characters that can be used for field recognition. These investigations also indicate several species remaining to be described, especially from Bolivia and Peru. The number of species estimated in *Symbolanthus* totals at least 30, including two species of the genus *Wurdackanthus* Maguire, which is now synonymized under *Symbolanthus* (Gould & Struwe, in prep.; Struwe & Gould, in prep.).

This paper describes two new species from Colombia that are distinctly different morphologically from *Symbolanthus calygonus*. Significantly, these more narrowly circumscribed species not only differ in leaf and floral morphologies from *Symbolanthus calygonus* sensu stricto, but the color scheme of the corolla is also more consistent within each species (i.e., each species has either the red-pink scheme or the white-yellow-green scheme). Some individuals have a mixture of corolla colors, such as a white tube on a red corolla or a pink tinge on a white corolla. As discussed below, *Symbolanthus tetrapterus* is exceptional because it has corollas varying in color from red-purple, through pink, to white and green. In contrast, *Symbolanthus pterocalyx* has a light green to yellow corolla (rarely pale pink or with pink markings).

The two new species described here have in common strongly quadrangular and 4-winged stems. In *Symbolanthus tetrapterus*, the calyx lobes are acute and non-alate. *Symbolanthus pterocalyx* differs in having long-acuminate calyx lobes with a long and thin hyaline keel, traits that are unique to this latter species. Several non-winged species of *Symbolanthus* are previously known from Colombia and are currently being revised (Struwe, in prep.).

Material and Methods

Herbarium material from HUA, K, MO, NY, U, and US was studied. Selected flowers from herbarium material were rehydrated in a solution of 70% ethanol, glycerol, and 5% Aerosol OT (9:1:1) for at least 24 hours.

Taxonomic Treatment

Symbolanthus pterocalyx Struwe, sp. nov. TYPE: Colombia. Antioquia: Santa Elena, 1500–2000 m, shrub 15 ft., fl. pale yellow-green, 1 Jan. 1930, *W. A. Archer 1287* (holotype, NY; isotypes, K, US). Figure 1.

Haec species *Symbolantho calygono* similis, sed ab ea caulibus manifeste alatis, lobis calycis longioribus longe-apiculatis manifeste alatis, tubo corollae calyce 1.0–1.25-plo longiore, et corollis albis, flavis vel viridis differt.

Shrub, branched, 0.6–4 m tall. *Branches* quadrangular, with interpetiolar lines; flowering stems 3–11 mm diam., internodes 1.2–4.8 cm long, winged; wing 1–3 mm wide. *Leaves* widely elliptic, (1.5–)2.0–2.5× longer than wide, broadest at the middle to slightly above, short- to long-petiolate, membranaceous when dry; lamina 5.5–16.2 × 1.6–6.5 cm; leaf apex acute to apiculate; leaf margin flat; leaf base long-attenuate; venation visible, 2 prominent pairs of basally divergent secondary veins; petiole 0.5–1.5(–2.0) cm long. *Inflorescence* 1- to 4(to 9)-flowered; subtending bracts and bracteoles linear to narrowly triangular, acute to acuminate, with dorsal keel, 9–12 × 2–3 mm at base; pedicel 26–42 mm long at anthesis, upper part of pedicel often keeled or 5-angular by decurrent calyx wings, pedicel 2–4 mm diam., transition from pedicel to flower gradual; flowers erect at anthesis. *Calyx* divided to ca. 0.8 of its length, at anthesis (2.6–)3.2–5.0 × (1.5–)2.0–2.9 cm; lobes narrowly ovate, (2.3–)2.8–4.0 × 1.1–1.7 cm, erect, but not tightly appressed to the corolla base, with a large, long, thin, often hyaline keel, 3–5 mm high, usually decurrent into the peduncle; apex long-apiculate (rarely acute); margin broadly hyaline; colleters (fingershaped, multicellular glands) present on large area on the inside of the base of each calyx lobe. *Corolla* broadly funnel-shaped, slightly zygomorphic with two lower lobes recurved, (5.0–)5.5–6.8(–7.8) cm long, basic color greenish white, pale yellow, yellow, to green (rarely pale pink), tube externally sometimes with reddish or pink lines, thin when dry; tube broadly widened toward mouth, straight, 1.0–1.25× longer than calyx, 3.4–5.0 cm long, 0.8–1.5 cm wide below insertion of stamens,

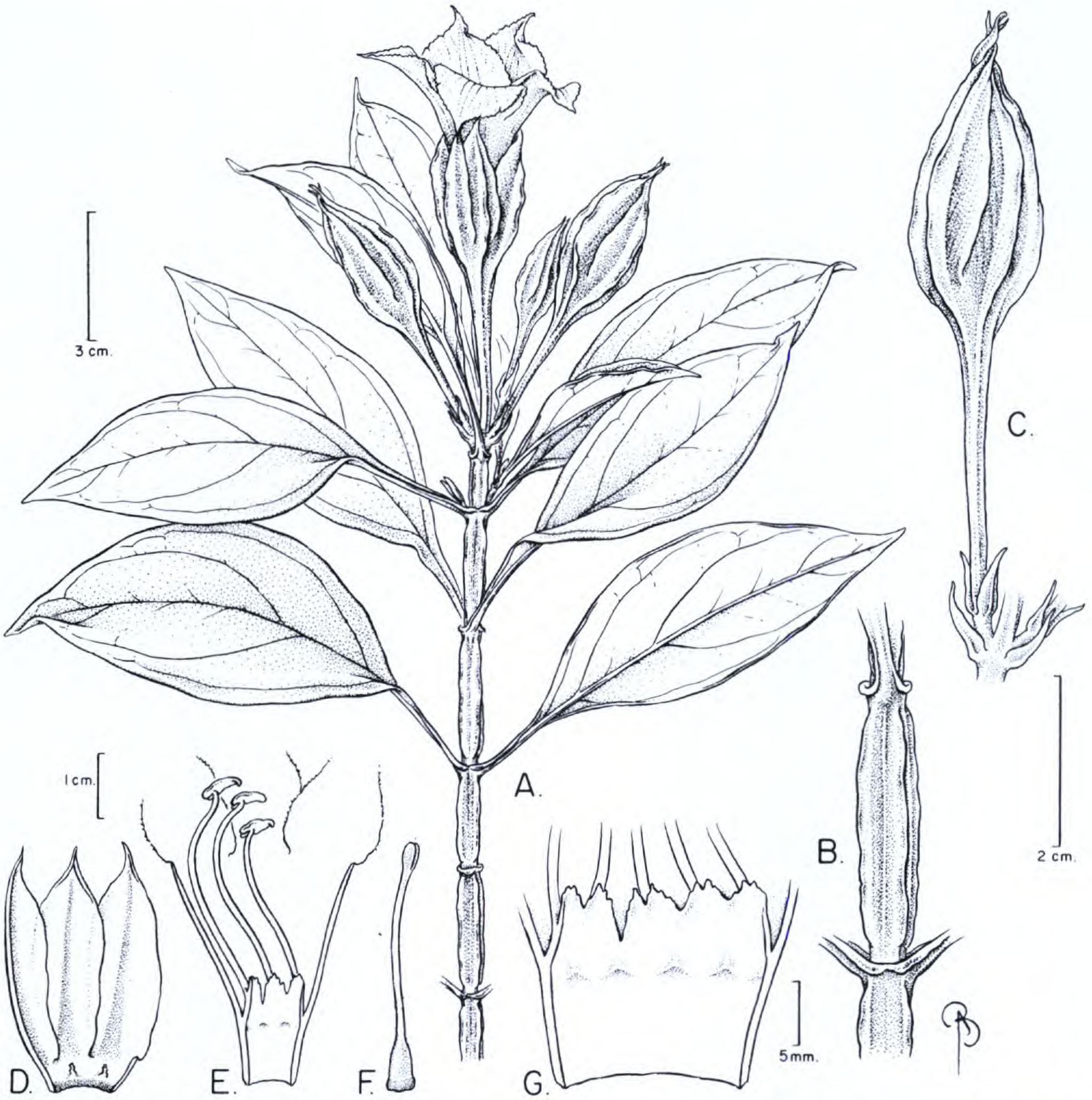

Figure 1. *Symbolanthus pterocalyx* Struwe (*Archer 1287*, K holotype, NY isotype: A–C; *Zarucchi & Cárdenas 4322*, NY paratype: D–G). —A. Habit of flowering stem. —B. Close-up of winged stem and interpetiolar lines. —C. Flower bud showing calyx lobes with dorsal ridges decurrent onto the pedicel and comparatively large, linear bracts. —D. Opened calyx with colleters (glands) on internal surface. —E. Opened corolla (partial) with stamens and corona. —F. Gynoecium with glandular disk at base of ovary. —G. Inside of corolla tube with corona and base of filaments.

(1.8–)2.6–3.0 cm wide at mouth; lobes broadly ovate, 2.0–3.0 × 2.3–2.8 cm, (1.0–)1.2–1.5× longer than wide, spreading to slightly reflexed at anthesis, apex abruptly (long-)apiculate; corolla apex in bud tapering. *Stamens* inserted ca. 7–15 mm from the base of the corolla; corona well-developed, ca. 10 mm tall, as a coronate ring with 5 plicae, basally fused with filaments, free part ca. 5–6 mm tall, with small pockets behind corona, plicae rectangular and 5–6 × ca. 4 mm, upper edge fimbriate; filaments inserted into anther at ca. 1/3–1/4 from base of anther; anthers white to cream (young), brown (older), ca. 6–9 mm long. *Ovary* ca. 6–7 mm long; style 28–35 mm long; stigma lobes oblong, green to white, 3–4 mm long. *Fruit* a fleshy-walled capsule, erect (rarely slightly nodding), broadly elliptic, 2.4–3.1 × 1.4–2.1 mm, same length or shorter than calyx, green, dehiscent, persistent basal part of style 8–23 mm long; calyx lobes 26–50 mm long in fruit; seeds angular, brown, ca. 1 mm.

Vernacular names. Suspiro (*Lehmann 5449*), Tabaquillo pequeño (*Giraldo et al. 1399*).

Phenology. Flowering specimens have been collected in all months of the year except October and December; fruiting specimens have been found during January to April and August to October.

Habitat and distribution. Symbolanthus pterocalyx only occurs in high-altitude cloud forests, subpáramo, and páramo habitats in the province of

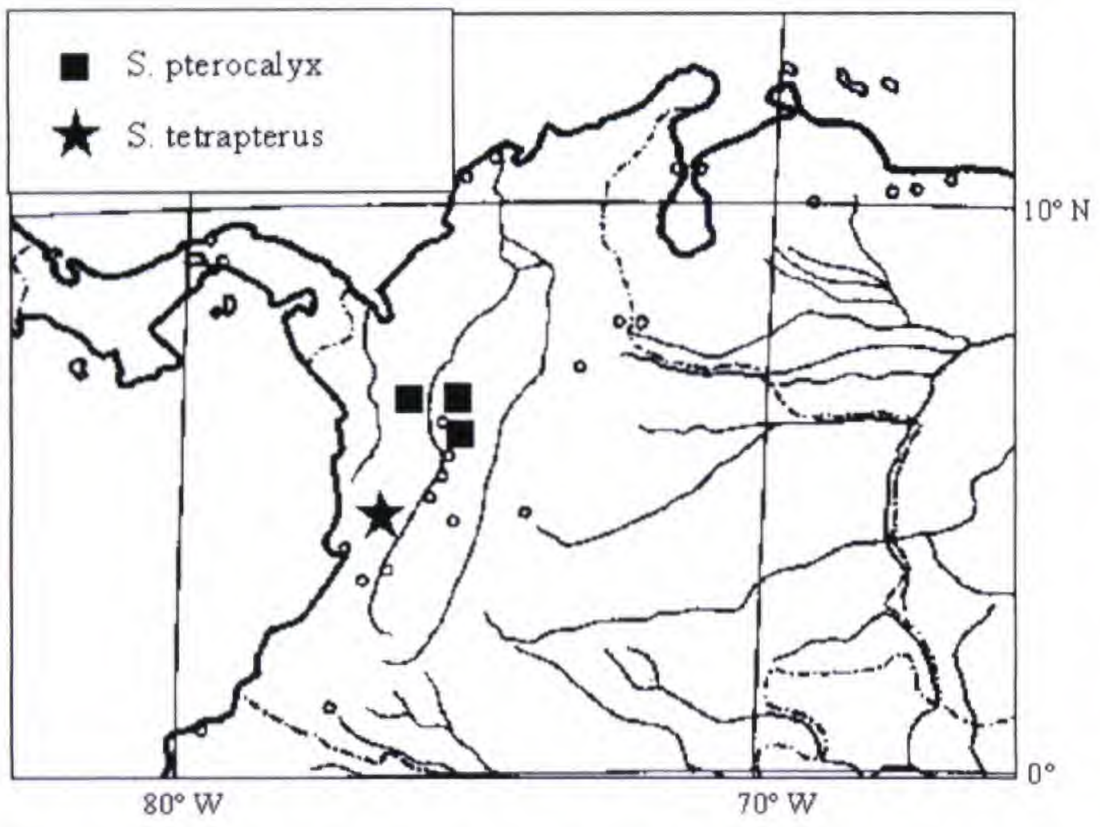

Figure 2. Distribution map for *Symbolanthus pterocalyx* and *S. tetrapterus*.

Antioquia, Colombia (Fig. 2). It has been found at Cerro del Padre Amaya, Páramo "El Morro," Páramo Sabanazo, Cerro San Félix, and Cerro Marcon in the Santa Helena area at altitudes between 1500 and 3200 m. Several collectors noted on herbarium labels that this is a common plant in these areas. It also grows in disturbed areas and is noted to recover degraded soils (vidi *Giraldo et al. 1399*: "USO: Pro[te]ctor de fuentes de agua, recuperador de suelos").

Etymology. This species is named *pterocalyx* (= winged calyx) after its prominent wings on the calyx.

Paratypes. COLOMBIA. **Antioquia:** Mun. Bello, corregimiento de San Félix, 5 June 1989, *Echeverri & Contreras 86* (HUA); Corregimiento San Félix (Torres de Telecomunicaciones), 22 May 1991, *Fonnegra & Curso Taxonomía Vegetal 3733* (HUA, U); Cerro San Félix, 11 Mar. 1992, *Fonnegra & Grupo Tax. Plan. Vasc. I Sem/92 3979* (HUA); Mun. de Caldas, Vereda La Corrala, FINCA "La Zarza," 28 Apr. 1986, *de Escobar & Giraldo 6649* (HUA); Mun. de Belmira, Páramo "El Morro," Proyecto Reserva Natural "El Páramo de Belmira," 22 Apr. 1993, *Fonnegra & Tuberquia 4637* (HUA, MO, U); Páramo Sabanazo, Estación Ecológica "El Refugio," 14 May 1996, *Fonnegra et al. 5984* (HUA); Mun. Buriticá, Corregimento El Guarco, Bosque Andino, 12 Mar. 2000, *Molina et al. 431* (HUA); Mun. de Envigado, borde de carretera y divorcio de aguas, 16 Apr. 1996, *Correa et al. 334* (HUA, JAUM not seen; det. here as cf. *pterocalyx*), 18 Apr. 1996, *Correa et al. 515* (HUA, JAUM not seen); recorrido límite Envigado, Caldas y El Retiro hacia el Oriente siguiendo el divorcio de aguas, 25 Apr. 1996, *Correa et al. 712* (HUA, JAUM not seen); Mun. Frontino, Corregimiento Nutibara, Vereda Alto de Cuevas, Quebrada del Oso, 23 Apr. 1991, *Fonnegra & Curso Taxonomía Vegetal 3536* (HUA, U); cuenca alta del Río Cuevas, 13 Jan. 1987, *Sánchez et al. 894* (HUA, MEDEL not seen), 13 July 1987, *Sánchez et al. 1366* (HUA, MEDEL not seen); Mun. de La Estrella, vereda El Romeral, sitio La Laguna, 17 Aug. 1992, *Giraldo-Cañas et al. 1085* (HUA); Mun. La Unión, Corregimiento San Miguel, carretera La Unión-Sonsón, borde de cañada, cerca al Río Piedras, 5 July 1987, *Marulanda et al. 304* (HUA); Mun. Medellín, Boquerón, Cerro del Padre Amaya, Feb. 1984, *Agudelo & Betancur 32* (HUA); Corregimiento San Cristobal, Ver. La Palma, 1 Apr. 1997, *Giraldo et al. 1399* (HUA, JAUM not seen); bosque de subparámo, antena de INRAVISION, 2 Sep. 1981, *Hoyos et al. 112* (HUA); ca. 19 km W of Medellín (rd. to Antioquia), cloud forests 5–10 km from highway along road to TV towers, 25 Mar. 1979, *Luteyn & Lebrón-Luteyn 7081* (HUA, NY); Militar, 15 May 1982, *Moreno & Buitrago 21* (HUA), 4 Aug. 1979, *Palacios et al. 85* (HUA); 11 km from Medellín–Santa Fé de Antioquia highway on road to summit, 18 Mar. 1987, *Zarucchi & Madrigal 4853* (HUA, MO, U); along road to Cerro del Padre Amaya, 10 km from Medellín–Santa Fé de Antioquia road, 15 Sep. 1987, *Zarucchi & Brant 5341* (HUA, MO), 4 Jan. 1969, *Uribe Uribe 6225* (US); Mun. de Santa Rosa, carretera hacia Aragón 5 km, 2 Oct. 1982, *Curso Ecología Vegetal, Universidad de Antioquia s.n.* (HUA); Mun. de Yarumal, Wächst in dichten laubwäldern um Yarumal, Nov. 1891, *Lehmann 5449* (K); N of Yarumal on road to Cerro Marconi (telecommunication towers for town), S slope near peak, 29 Nov. 1986, *Zarucchi & Cárdenas 4322* (HUA, MO, NY, U); unknown municipality, Santa Helena, forest bond., 9 Jan. 1880, *Kalbreyer 1304* (K); Rionegro, 24 Jan. 1992, *Vargas 790* (HUA).

Symbolanthus tetrapterus Struwe, sp. nov. TYPE: Colombia. Chocó: Mun. San José del Palmar, Cerro del Torrá, cumbre del Torrá Grande, 2770 m, 13 Jan. 1984, *F. A. Silverstone-Sopkin, N. Paz, A. Duque & H. Bayona 1803* (holotype, U; isotypes, CUVC, MO). Figure 3.

Haec species *Symbolantho calygono* similis, sed ab ea caulibus manifeste alatis, foliis obovatis vel obovatis-oblongis sessilis (raro subsessilis), et calycibus non alatis differt.

Shrub, branched, 1–4 m tall. *Branches* quadrangular, with interpetiolar lines; flowering stems 5–8 mm diam.; internodes 11–39 mm long, winged, wing broader toward upper part of each internode, often with a wavy to undulating edge; wing (0.5–) 1.5–3.0 mm wide. *Leaves* obovate or obovate-oblong, 2.0–2.5× longer than wide, broadest above middle, sessile (seldom subsessile), membranaceous to slightly coriaceous when dry; lamina 3.2–12.9 × 1.3–6.3 cm; leaf apex rounding to acute apex; leaf margin flat; leaf base cuneate; venation visible, 2 pairs of basally divergent secondary veins; petiole 0(–5) mm long. *Inflorescence* 1- to 4-flowered; subtending bracts and bracteoles triangular, acute, membranaceous, 2–3 mm long, ca. 3 mm wide at base; pedicel 18–29 mm long at anthesis, terete, 2–3 mm diam., transition from pedicel to flower gradual; flowers erect at anthesis. *Calyx* divided to ca. 0.9 of its length, at anthesis 2.2–2.8 × 1.3–1.5 cm; lobes narrowly ovate, 1.3–2.5 × 0.8–1.0 cm, appressed (but not tightly) to the corolla base, without dorsal keel, but dorsally thick-

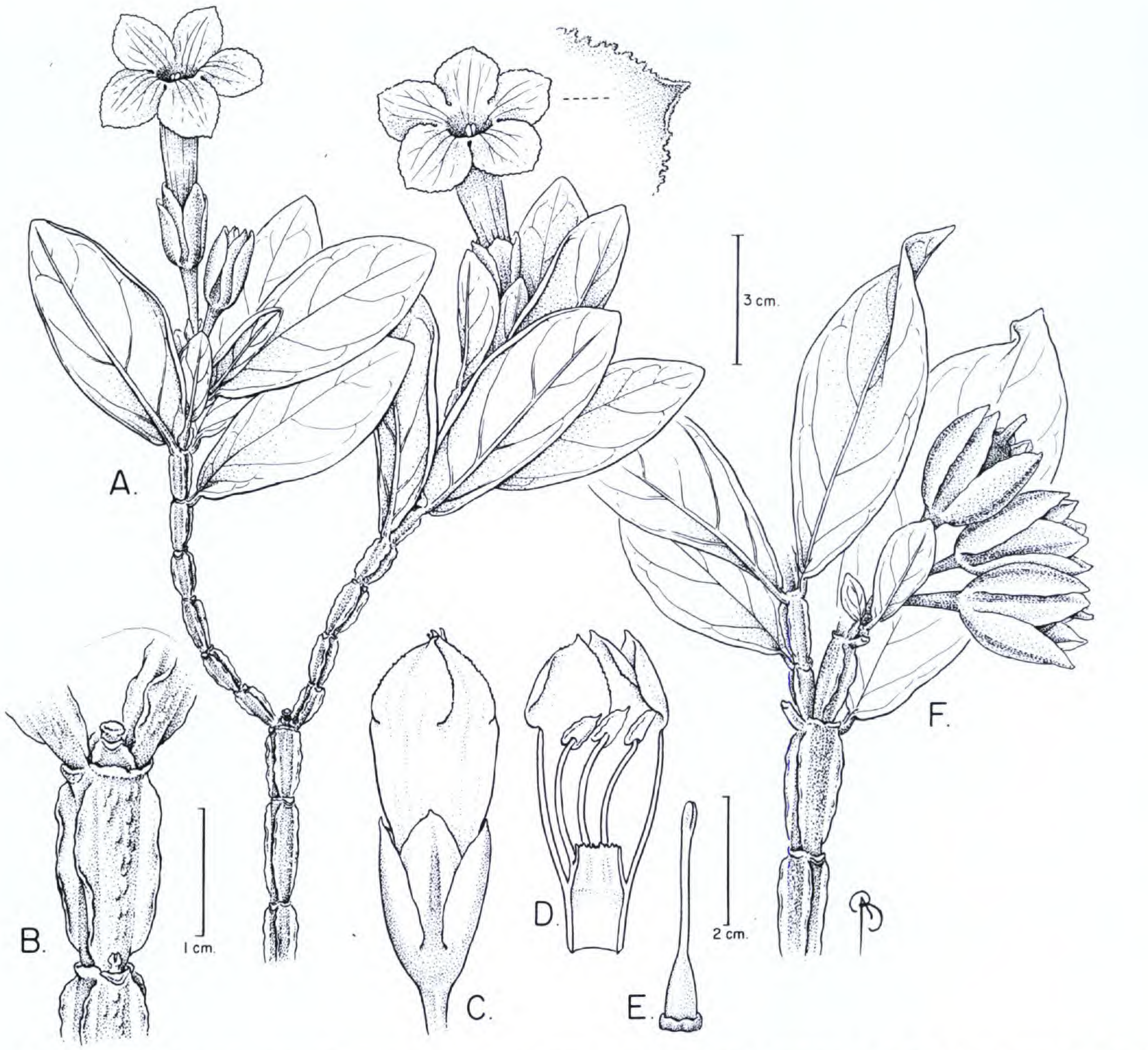

Figure 3. *Symbolanthus tetrapterus* Struwe (*Silverstone-Sopkin et al. 1803*, MO isotype: A, B, F; *Silverstone-Sopkin et al. 4140*, U paratype: C–E). —A. Habit of flowering stem, with close-up of erose corolla lobe apex at right. —B. Close-up of winged stem and interpetiolar lines. —C. Flower before anthesis showing non-keeled calyx lobes. —D. Inside of corolla with corona and anthers. —E. Gynoecium (note glandular base of ovary). —F. Close-up of branch with young fruits.

ened; apex acute, mucronate; margin very broadly hyaline; colleters present as a glandular colleter area on the inside of the base of each calyx lobe. *Corolla* narrowly funnel-shaped, actinomorphic, 6.2–6.8 cm long, basic color white, green, pink (less often dark pink to red-purple), sometimes also the corolla tube white internally, green externally, and corolla lobes showy dark pink (vidi *Silverstone-Sopkin et al. 4140*), thin when dry; tube cylindric to slightly widened toward mouth, straight, 2.0–2.5× longer than calyx, 4.8–5.2 cm long, ca. 0.7 cm wide below insertion of stamens, 1.2–2.2 cm wide at mouth; lobes broadly ovate, 1.5–2.0 × 1.5–2.0 cm, 1.0–1.3× times longer than wide, erect to spreading at anthesis, apex obtuse, with a small apiculate tip; corolla apex in bud tapering. *Stamens* inserted ca. 10–15 mm from the base of the corolla; corona well-developed, ca. 10 mm tall, as a coronate ring with fused upper edge, with small pockets between corona and corolla, fused with filaments for 5 mm, upper portion (5–6 mm tall) free from the filaments, corona edge uneven, papillate; filaments inserted into anther ca. 1/4 from base of anther; anthers white, 6–7 mm long. *Ovary* ca. 6–7 mm long; style ca. 2 cm long; stigma lobes oblong, ca. 3 mm long. *Fruit* a fleshy-walled capsule, nodding, globose to elliptic, 2.0–3.4 × 1.8–2.4 cm wide, same length as calyx, green, probably dehiscent, persistent basal part of style 2–6(–22) mm long; calyx lobes 2.1–3.0 cm long in fruit; seeds not seen.

Phenology. Flowering and fruiting specimens have been collected in January and August.

Table 1. Comparison of the two new species *Symbolanthus pterocalyx* and *S. tetrapterus* with *S. calygonus*.

	S. calygonus	*S. pterocalyx*	*S. tetrapterus*
Wings on stem	not or barely winged	prominently winged	prominently winged
Leaf shape	elliptic-lanceolate	widely elliptic	obovate to obovate-oblong
Leaves petiolate vs. sessile	distinctly petiolate leaves	distinctly petiolate leaves	sessile (rarely subsessile)
Leaf base	cuneate	cuneate	strongly attenuate
Bract length	4–10 mm	10–12 mm	2–3 mm
Calyx lobe length	1.5–2.4 cm	2.8–4.0 cm	1.3–2.5 cm
Calyx lobe apex	obtuse to slightly acute	long-apiculate	acute, mucronate
Calyx wings	short "hump-like" keel	long thin wing on the back of each calyx lobe, often decurrent	wing absent
Corolla tube length vs. calyx length	2–3× longer	1.0–1.25× longer	2.0–2.5× longer
Corolla color	pink to red	white, yellow, to green (rarely pale pink)	green, white, pink, or red-violet corollas
Distribution	Peru: Huánuco	Colombia: Antioquia	Colombia: Chocó

Habitat and distribution. *Symbolanthus tetrapterus* is known only from Cerro del Torrá in southern Chocó in Colombia (Fig. 2). It grows in several habitats on this mountain at ca. 1900–2800 m altitude, from disturbed shrubby vegetation, primary forests, to open páramo vegetation summit dominated by *Neurolepis* Meissner, *Paepalanthus* Kunth, *Blechnum* P. Browne, and Rubiaceae and Melastomataceae shrubs and very few dwarf trees, but devoid of *Espeletia* Mutis ex Bonpland (Silverstone-Sopkin & Ramos-Pérez, 1995). This type of páramo-like vegetation usually occurs at a higher altitude in the Andes, and its occurrence on Cerro del Torrá is probably due to wind exposure (Silverstone-Sopkin & Ramos-Pérez, 1995).

Etymology. This species epithet is derived from *tetrapterus* (or 4 wings) after its four prominent and decurrent wings along the stems.

Paratypes. COLOMBIA. **Chocó:** Municipio San José del Palmar, Cerro del Torrá, vertiente nordeste, 8 Aug. 1982, *Silverstone-Sopkin 1260* (CUVC, MO); cumbre, 8 Aug. 1982, *Silverstone-Sopkin 1268* (CUVC, MO); vertiente nororiental, arriba del helipuerto, 6 Jan. 1984, *Silverstone-Sopkin et al. 1587* (CUVC, MO, U); cumbre del Torrá Grande, 13 Jan. 1984, *Silverstone-Sopkin et al. 1804* (CUVC, MO); vertiente oriental, helipuerto, 6 Aug. 1988, *Silverstone-Sopkin et al. 4140* (CUVC 2 sheets, NY, U); filo de cumbre, 15 Aug. 1988, *Silverstone-Sopkin et al. 4421* (CUVC, U), 15 Aug. 1988, *Silverstone-Sopkin et al. 4422* (CUVC, U), 21 Aug. 1988, *Silverstone-Sopkin et al. 4664* (CUVC, U).

Discussion

Symbolanthus pterocalyx differs from *S. calygonus* in several notable characters (Table 1). These include prominently winged stems (vs. not or barely winged stems), longer bracts (10–12 mm vs. 4–10 mm), longer and long-apiculate calyx lobes (28–40 mm vs. 15–24 mm and obtuse to slightly acute) with a long thin wing on the back of each calyx lobe (vs. a short "hump-like" keel), corolla tube 1.0–1.25 times longer than calyx (vs. 2–3 times), and white, yellow, to green corollas (vs. pink to red). Only one known collection of *Symbolanthus pterocalyx* has corollas that are recorded as pale pink (*Zarucchi & Cárdenas 4322*) as opposed to yellow and green, so corollas of the pink-red color scheme are very uncommon in this species. In a few specimens the calyx keels are not strongly developed toward the apex of the calyx lobes, but the keels are always present at the very upper portion of the pedicel to the base of the calyx lobes. Usually the same specimens that have less well-developed wings on the stems will always have the long and acuminate calyx lobes (at least somewhat keeled) and greenish yellowish corollas (e.g., *Fonnegra et al. 5984*). The calyx wings are often decurrent as ridges down onto the pedicel (e.g., in *Marulanda et al. 304*, where the wings from the two outer calyx lobes reach down to the base of the pedicel and cause it to be distinctly flattened in cross section).

Gentians are rarely eaten by insects and other herbivores, but several collections of *Symbolanthus pterocalyx* have circular to 5 mm large holes in their leaves (e.g., *Marulanda et al. 304*, *Vargas 790*). Nearly all gentians contain large amounts of extremely bitter chemical compounds (seco-iri-

doids; Samuelsson, 1992: 153; Jensen & Shripsema, 2002), but it is not known if these reduce herbivory. Furthermore, according to herbarium label information from *Agudelo & Betancur 32*, in *Symbolanthus pterocalyx*, wasps (Vespidae) are associated with the hollow stems and beetles (Coleoptera) are found in the (presumably floral) receptacles. Hummingbirds have been recorded as visitors to a *Symbolanthus tetrapterus* plant with white to green-colored corollas (*Silverstone-Sopkin et al. 4140*).

Symbolanthus tetrapterus differs from *S. calygonus* in its prominently winged stems (vs. not or barely winged stems), obovate to obovate-oblong and sessile (rarely subsessile) leaves (vs. elliptic-lanceolate and distinctly petiolate leaves) with a strongly attenuate base (vs. cuneate), shorter bracts (2–3 mm vs. 4–10 mm), non-alate calyces (vs. a dorsal keel on each calyx lobe), and green, white, pink, or red-violet corollas (vs. always pink to red; Table 1).

The mountain Cerro del Torrá is an isolated outlier west of the Cordillera Occidental of the Andes and reaches about 2800 m elevation. It is the only known locality of *Symbolanthus tetrapterus*, and over 25 other endemic plant species have been described from this mountain (in Ericaceae, Melastomataceae, Orchidaceae, and Solanaceae). In fact, of the three gentians so far found on Cerro del Torrá, possibly two are endemic to this mountain (*Symbolanthus tetrapterus* and *Macrocarpaea* sp. nov., J. R. Grant, unpublished). The floristic study of Cerro del Torrá by Silverstone-Sopkin and Ramos-Pérez (1995) showed an overwhelming floristic affinity between Cerro del Torrá and the Cordillera Occidental. This result suggested that this mountain is not a phytogeographical entity distinct from the Cordillera Occidental.

The phylogenetic relationships of *Symbolanthus pterocalyx* and *S. tetrapterus* are uncertain at present, and the closest relatives to each cannot be discerned based on simple comparison of morphological traits. Molecular studies including other species of *Symbolanthus* have shown that sequence variation in the fast-evolving 5S-NTS nrDNA region is very low and does not resolve species relationships in Andean *Symbolanthus* very well (Gould & Struwe, in prep.). However, molecular data suggest that there is support for the hypothesis that green-white vs. red-pink-flowered species do not constitute major monophyletic groupings. These two new species are not very similar to each other apart from their winged stems, and other morphological features do not suggest a close relationship to each other. *Symbolanthus pterocalyx* from Antioquia shows more similarities with the eastern Andean species *S. vasculosus* in its long-petiolate leaves and large, campanulate corolla with wide corolla lobes, inferring possible bat pollination. The more southern *Symbolanthus tetrapterus* has sessile leaves and salver-shaped flowers indicating hummingbirds as possible pollinators. Both species have winged stems but this character occurs in other species as well, e.g., *Symbolanthus vasculosus*. The presence of winged stems in these species is probably due to parallel evolution of this trait in geographically separated populations, rather than a result of common ancestry. Further phylogenetic studies are needed, and until suitable DNA markers become available, hypotheses about species relationships will have to be based on selected morphological characteristics alone.

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Aculeatae, a New Series in *Bauhinia* Section *Pauletia* (Leguminosae, Caesalpinioideae, Cercideae)

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ABSTRACT. *Bauhinia* ser. *Aculeatae* Vaz & A. M. G. Azevedo, a new series in section *Pauletia*, is established as separate from *Bauhinia* ser. *Cansenia* (Rafinesque) Wunderlin, K. Larsen & S. S. Larsen. A description of the new series is presented together with a description of series *Cansenia* newly circumscribed.

Key words: *Bauhinia* sect. *Pauletia*, Brazil, Caesalpinioideae, Cercideae, Leguminosae.

Bauhinia L. is a pantropical genus of tribe Cercideae (Leguminosae, Caesalpinioideae). Wunderlin's (1976) and Wunderlin et al.'s (1981, 1987) studies led to a classification of the Cercideae, including 4 subgenera, 22 sections, and 30 series for *Bauhinia*. *Bauhinia* sect. *Pauletia* (Cavanilles) DC. is characterized by the presence of 10 fertile stamens or by 5 fertile stamens alternating with 5 staminodes with reduced anthers or, rarely, with 6 to 8 fertile stamens and 2 to 4 staminodes. In all cases, filaments are connate at the base and generally have pollen grains with a reticulated sexine and with a supratectal gemoid process. Section *Pauletia* encompasses ca. 70 species in tropical America and 2 species in southern Asia, South China, and the Malesian Area, according to Wunderlin et al. (1987). In tropical America, its distribution ranges from Mexico to Argentina, encompassing 53 species of *Bauhinia* in Brazil (Vaz, 2001).

Bentham (1870) divided *Bauhinia* sect. *Pauletia* into three informal groups of species based on the attributes of petals and stamens: (1) narrow petals, 10 perfect stamens, without prickles; (2) narrow petals, alternate (antepetalous) filaments with smaller or deficient anthers or anantheriferous, prickles robust-growing; (3) obtuse petals, 10 perfect stamens, prickles robust-growing. Wunderlin et al. (1987) divided *Bauhinia* sect. *Pauletia* into five series, including also features of the calyx, pollen, and fruits: *Bauhinia* ser. *Cansenia* (Rafinesque) Wunderlin, K. Larsen & S. S. Larsen, *B.* ser. *Acuminatae* Wunderlin, K. Larsen & S. S. Larsen, *B.* ser. *Perlebia* (Martius) Wunderlin, K. Larsen & S. S. Larsen, *B.* ser. *Pentandrae* Wunderlin, K. Larsen & S. S. Larsen, and *B.* ser. *Ariaria* (Cuervo Marquez) Wunderlin, K. Larsen & S. S. Larsen. Here, the first and third groups proposed by Bentham (1870) whose species have 10 perfect anthers were merged into series *Cansenia*. Nevertheless, Wunderlin's *Cansenia* comprises two distinct groups in *Bauhinia* and should therefore be divided into series corresponding roughly to the first and third informal groups proposed by Bentham (1870).

This paper, which is part of a more extensive taxonomic study of *Bauhinia* sect. *Pauletia* (Vaz, 2001), emends the taxonomic circumscription of its inclusive series *Cansenia* and proposes a new separate series. To circumscribe both series, we have added the following new diagnostic characters: inflorescence type, the presence/absence of prickles, and the presence/absence of the extrafloral nectaries. The inflorescences in Neotropical *Bauhinia* sect. *Pauletia* are terminal pseudoracemes, which always have successively geminate pedicels. The sympodium is leafy at base, or the leaves are replaced by foliaceous bracts (series *Cansenia* and *Ariaria*). In another group of species (series *Aculeatae*, *Pentandrae*, *Perlebia*), flowers are arranged in 2(3–6) leaf-opposed clusters (cymoids). These inflorescences are of terminal origin, although referred to as axillary or supra-axillary by most authors. Both types of inflorescence (pseudoracemes and cymoids) have already been recognized in *Bauhinia* by Urban (1885). Structures described by Bentham (1870) as "aculei" (= prickles) are in fact prickles in some species and extrafloral nectaries in others. The extrafloral nectaries, as recognized here, were first detected for *B. curvula* Bentham (Resende et al., 1994, see fig. 1), although

a "nectar secreting thread" has already been recorded by van der Pijl (1952: 292) for an American species not identified. The extrafloral nectaries are smaller, not pungent, intrastipular projections, 1–2 mm long, subulate or ovoid in shape. They are also presented in pseudoracemes as paired projections from foliaceous bracts. In some species extrafloral nectaries may be rudimentary or obsolete. Adpeciolar prickles are always pungent, straight or hook-shaped, 1–10 mm long. They are positioned below or beside the adjacent stipules. In some species, the alternate prickle may be rudimentary or obsolete.

Bauhinia ser. **Cansenia** (Rafinesque) Wunderlin, K. Larsen & S. S. Larsen, Biol. Skr. 28: 12. 1987, hic emendavit. Basionym: *Cansenia* Rafinesque, Sylva Tellur. 122. 1838. TYPE: *Cansenia ungulata* (L.) Rafinesque (lectotype, designated by Wunderlin (1976)).

Plant with terminal branches ascendent, prickles absent; extrafloral nectaries present or rudimentary. Inflorescence a terminal pseudoraceme, leafless, with foliaceous bracts or sometimes with scattered reduced leaves toward the apex, partial inflorescence adnate to the main axis by geminate pedicels, (1–)2(–3)-flowered; calyx at anthesis irregularly connate at the apex and splitting into 2 to 5 lobes; petals narrow, acute or acuminate or obtuse (only in *B. cheilantha*); 10 fertile stamens, connate at the inner internal face, but without ligular appendix.

Suffrutescent, about 0.5–2 m high, when growing in "campo" open formations or Brazilian savannas, with a conspicuous xylopodium—a subterranean organ adapted for vegetative propagation during rainy periods, after a long-lasting dry season and periodical burning of the aerial portion of plant cover (Rizzini & Heringer, 1961, 1962). Also found growing as trees or treelets, 4–15 m tall in forest, including gallery forests. The multi-stemmed shrubby habit is found in Brazilian savannas (burned periodically with scattered trees and a herbaceous ground cover), secondary forests, and disturbed areas in Brazil.

Pollen triangular-shaped in polar view, angulaperturate 3(4) colpi short, covered with a colpus membrane (figs. 10–14 in Ferguson & Pearce, 1986; Melhem & Labouriau, 1963; Vaz, 2001, part 1, fig. 16D).

This series, here newly circumscribed, corresponds to the first group of *Bauhinia* sect. *Pauletia* (Bentham, 1870), except for *Bauhinia marginata* (Bongard) Steudel and *Bauhinia hirsuta* (Bongard) Vogel (= *B. hirsutiflora* Vaz), both species belonging to series *Pentandrae*.

Species Included

1. *Bauhinia acuruana* Moricand, Pl. Nouv. Amér. 6, p. 77, tab. 5. 1840.
2. *Bauhinia aureopunctata* Ducke, Arch. Jard. Bot. Rio de Janeiro 4: 53. 1925.
3. *Bauhinia bombaciflora* Ducke, Arch. Jard. Bot. Rio de Janeiro 3: 104, fig. 5. 1922.
4. *Bauhinia brevipes* Vogel, Linnaea 13: 307. 1839.
5. *Bauhinia burchellii* Bentham, in Martius, Fl. Bras. 15(2): 186. 1870.
6. *Bauhinia caloneura* Malme, Bih. Kongl. Svenska Vetensk.–Akad. Handl. 25 (3, n° 11): 29. pl. 2. 1900.
7. *Bauhinia campestris* Malme, Ark. Bot. 5(5): 10. 1905.
8. *Bauhinia candelabriformis* R. S. Cowan, Contr. Sci. Los Angeles County Mus. 13: 4, fig. 1. 1957.
9. *Bauhinia cheilantha* (Bongard) Steudel, Nom. Bot., ed. 2, v. 1, p. 191 sphalm. 291. 1840.
10. *Bauhinia cinnamomea* DC., Prodr. p. 517. 1825.
11. *Bauhinia conwayi* Rusby, Bull. New York Bot. Gard. 8(28): 92. 1912.
12. *Bauhinia cupulata* Bentham, in Martius, Fl. Bras. 15(2): 188. 1870.
13. *Bauhinia curvula* Bentham, in Martius, Fl. Bras. 15(2): 194. 1870.
14. *Bauhinia dubia* G. Don, Gen. Syst. 2, p. 463. 1832, non *B. dubia* Vogel.
15. *Bauhinia dumosa* Bentham, in Martius, Fl. Bras. 15(2): 194. 1870.
16. *Bauhinia fusconervis* (Bongard) Steudel, Nom. Bot. ed. 2, v. 1, p 1, p. 191 sphalm. 291. 1840.
17. *Bauhinia gardneri* Bentham, in Martius, Fl. Bras. 15(2): 186. 1870.
18. *Bauhinia goyazensis* Harms, Bot. Jahrb. Syst. 33(72): 21. 1903.
19. *Bauhinia grandifolia* (Bongard) Steudel, Nom. Bot. ed. 2, v. 1, p. 191 sphalm. 291. 1840.
20. *Bauhinia holophylla* (Bongard) Steudel, Nom. Bot. ed. 2, v. 1, p. 191 sphalm. 291. 1840.
21. *Bauhinia leptantha* Malme, Ark. Bot. 5(5): 11. 1905.
22. *Bauhinia longicuspis* Bentham, in Martius, Fl. Bras. 15(2): 185. 1870.
23. *Bauhinia longifolia* (Bongard) Steudel, Nom. Bot. ed. 2, v. 1, p. 191 sphalm. 291. 1840.
24. *Bauhinia longipedicellata* Ducke, Arch. Jard. Bot. Rio de Janeiro 4: 105. 1922.

25. *Bauhinia malacotricha* Harms, Bot. Jahrb. Syst. 33(72): 22. 1903.
26. *Bauhinia malacotrichoides* Cowan, Contr. Sci. Los Angeles County Mus. 13: 8, fig. 3. 1957.
27. *Bauhinia membranacea* Bentham, in Martius, Fl. Bras. 15(2): 187. 1870.
28. *Bauhinia pulchella* Bentham, in Martius, Fl. Bras. 15(2): 190. tab. 49. 1870.
29. *Bauhinia rufa* (Bongard) Steudel, Nom. Bot. ed. 2, v. 1, p. 192. 1840.
30. *Bauhinia smilacifolia* Bentham, in Martius, Fl. Bras. 15(2): 183. 1870.
31. *Bauhinia subclavata* Bentham, in Martius, Fl. Bras. 15(2): 188. 1870.
32. *Bauhinia tenella* Bentham, in Martius, Fl. Bras. 15(2): 195. 1870.
33. *Bauhinia ungulata* L., Sp. Pl. ed. 1, p. 374. 1753.
34. *Bauhinia urocalyx* Harms, Notizbl. Königl. Bot. Gart. Berlin 6(59): 308. 1915.

Bauhinia ser. **Aculeatae** Vaz & A. M. G. Azevedo, ser. nov. TYPE: *Bauhinia aculeata* L.

Rami terminales vulgo subhorizontales, aculei gemini vel subsolitarii; nectaria extrafloralia nulla. Inflorescentiae foliosae, partiales unilaterales, 2(3–6)-florae; calyx per anthesin in spatham deflexam hinc fissus ad basim; petala lata, oblanceolata vel spathulata; stamina 10, omnia fertilia, base interne appendice ligulari praedita.

Plant with terminal branches subhorizontal, prickles paired or subsolitary; extrafloral nectaries absent. Inflorescence leafy, partial inflorescences unilateral, 2(3–6)-flowered, calyx spathaceous at anthesis and then splitting to the base, petals broad, oblanceolate or spathulate; stamens 10, all fertile, at inner base with ligular appendix.

Trees or treelets, ca. 4–15 m tall, found in forest formations in tropical America, including gallery forests of Brazilian cerrado, but never suffrutescent, although they may survive as multi-stemmed shrubs in secondary forest, including disturbed adjacent sites. In high-altitude grassland ("campos de altitude") in southeastern Brazil, in Rio de Janeiro and São Paulo states, they may occur as treelets.

Pollen (4–)5–6-zonocolpate with colpi wide and short (= type 3 subtype b, in Gamerro & Fortunato, 2001, figs. 5–7; Vaz, 2001, part 1, fig. 16B; see also Barth & Bousada, 1964, figs. 1, 2).

This series corresponds to the third group of *Bauhinia* sect. *Pauletia* (Bentham, 1870), excluding *Bauhinia corniculata* Bentham, which belongs to series *Pentandrae* and *B. cheilantha* cited above, under series *Cansenia*.

Species Included

1. *Bauhinia acreana* Harms, Notizbl. Königl. Bot. Gart. Berlin 6: 307. 1915.
2. *Bauhinia aculeata* L., Sp. Pl. ed. 1, 374. 1753.
3. *Bauhinia affinis* Vogel, Linnaea 10: 594. 1836.
4. *Bauhinia albicans* Vogel, Linnaea 13: 304. 1839.
5. *Bauhinia caatingae* Harms, Bot. Jahrb. Syst. 42: 209. 1908. (from caatinga, a Brazilian vegetation type; sphalm. *catingae*).
6. *Bauhinia forficata* Link, Enum. Hort. Berol. 1: 404. 1821.
7. *Bauhinia integerrima* Bentham, in Martius, Fl. Bras. 15(2): 197. 1870.
8. *Bauhinia mollis* (Bongard) D. Dietrich, Syn. Pl. 2: 1475. 1840.
9. *Bauhinia ovata* (Bongard) Vogel, Linnaea 13: 300. 1839.
10. *Bauhinia platypetala* Bentham, in Martius, Fl. Bras. 15(2): 198. 1870.

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An Overview of the Subspecies of *Paullinia obovata* (Sapindaceae–Paullinieae) in Peru

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ABSTRACT. An overview of the subspecies of *Paullinia obovata* in Peru is presented, recognizing five subspecies. One new subspecies, *P. obovata* subsp. *flava* Weckerle & Igersheim, is described. *Paullinia brentberlinei* is transferred to the rank of subspecies of *P. obovata*. Three varieties of *P. obovata*, i.e., var. *obovata*, var. *polymorpha*, var. *subrotunda*, are recognized at the subspecies level. All subspecies are illustrated, and their comparative morphological features are compared in a table.

RESUMEN. Se presenta una revisión de las subespecies de *Paullinia obovata* en Peru. Son reconocidas cinco subespecies. Se describe una nueva subespecie, *P. obovata* subsp. *flava* Weckerle & Igersheim. *Paullinia brentberlinei* es reducida a una subespecie de *P. obovata*. Tres variedades de *P. obovata* (var. *obovata*, var. *polymorpha*, var. *subrotunda*) son reconocidas como subespecies. Se provee una tabla resumen con los caracteres morfológicos para la comparación de los taxa, así como ilustraciones para cada uno de ellos.

Key words: *Paullinia*, Paullinieae, Peru, Sapindaceae.

The tribe Paullinieae (Sapindaceae) mainly occurs in tropical America; exceptions are a few species of *Cardiospermum* L. with a pantropical distribution and *Paullinia pinnata* L., which is also found in tropical Africa and Madagascar (Radlkofer, 1933). The tribe consists of lianas (plants growing in open areas may be non-climbing treelets) and vines with tendrils, a growth form not very common to the Sapindaceae and found in the Paullinieae sensu Radlkofer (1933) only. The genera of this tribe have very similar flowers, characterized by zygomorphy and four petals with basal appendages. The taxa are separated mainly by fruit and seed characters.

Paullinia L. is the second largest genus of the tribe Paullinieae with about 200 species. Most of them occur in the rain forests of Amazonia. About 70 species are found in Peru (Simpson, 1976; Gereau, 1993), chiefly in the lowland rain forest and the rain forest of the eastern Andean slopes. The genus *Paullinia* is polymorphic with regard to vegetative features as well as fruit and seed morphology. Cross sections of the stems have a single stele or less commonly numerous steles, which means that a central stele can be surrounded by one, two, or three peripheral steles. The leaves are alternate and often 5-foliolate pinnate but may vary from 3-foliolate to biternate or multifoliolately ternate-pinnate, with margined or winged petioles and rachises. The 3-valved capsules are stipitate, subsessile to sessile, 3-locular, and uniovulate. *Paullinia* can be divided into three main species groups, differing conspicuously in macromorphological fruit characters. (1) The majority of taxa (± 2/3) are characterized by globose, subglobose, fusiform, obovate, or clavate fruits; (2) several species (± 1/3) have fruits with dorsal wing-like outgrowths; (3) five species have echinate fruits (Radlkofer, 1933). The mature capsules are often reddish, more rarely yellowish or greenish. The seeds are globose, ovate, ellipsoid, or compressed ellipsoid with a black or brown exotesta. They are partly or totally enclosed with a white aril (actually an arilloid sensu van der Pijl (1957)) of different texture.

Paullinia obovata (Ruiz & Pavón) Persoon is restricted to western Amazonia (Ecuador, Peru, Bolivia, and adjacent regions of Colombia and Brazil) with its main distribution in Peru (Simpson, 1976). The stem has a single stele, the leaves are 5-foliolate pinnate with unwinged or occasionally margined petioles and rachises, and the capsules are stipitate or subsessile, 2.5–9.0 cm long, with thick and fibrous valves. The usually three seeds are at least half enclosed by a sweet aril.

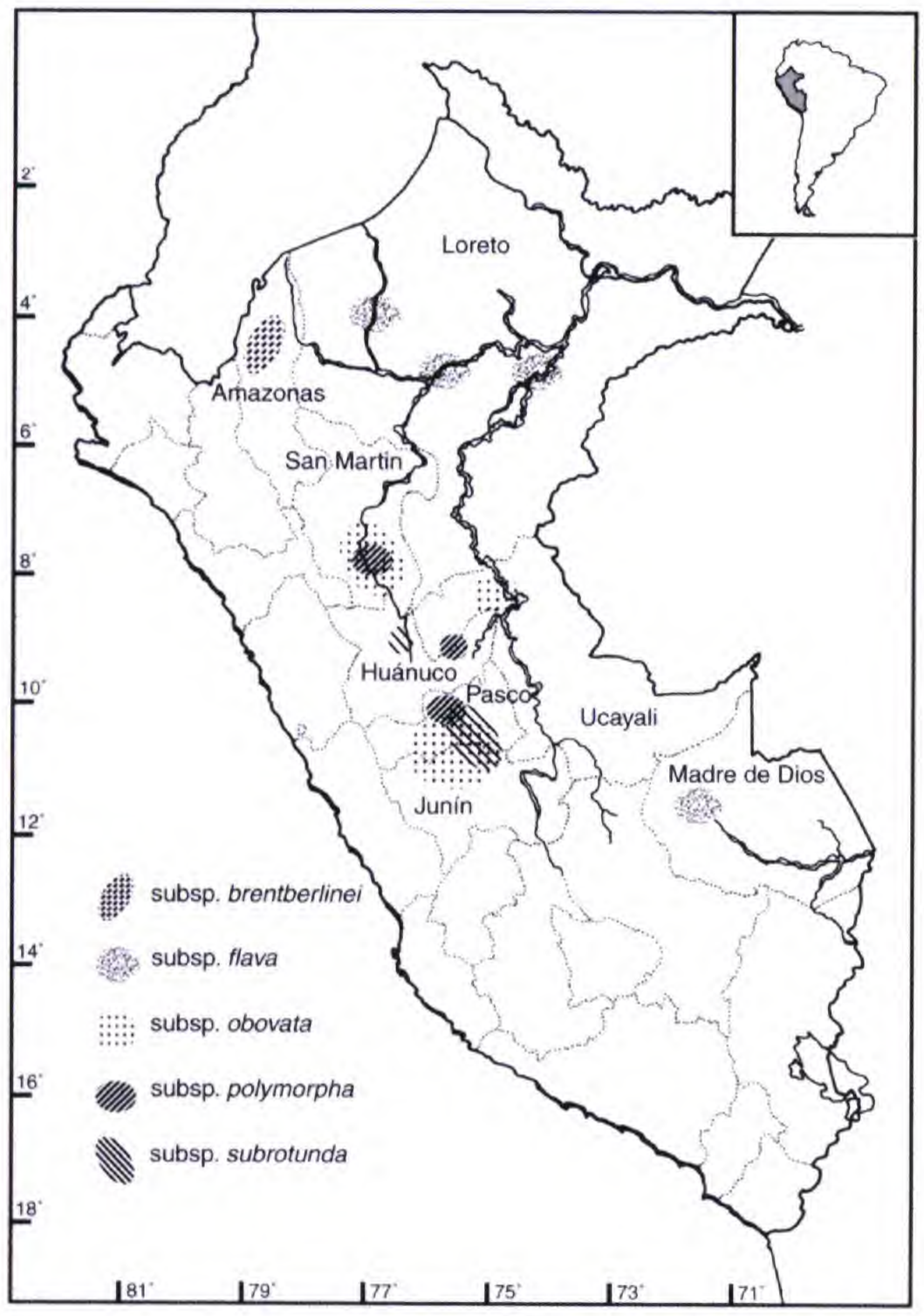

Figure 1. Geographic distribution of the subspecies of *Paullinia obovata* in Peru, based on specimen locations.

The new subspecies *Paullinia obovata* subsp. *flava* Weckerle & Igersheim was found in the lowlands of Peru in the vicinity of Jenaro Herrera, department Loreto. Examination of herbarium material (USM) showed that this subspecies also occurs further south in the department Madre de Dios (Fig. 1). It differs from the other subspecies mainly by its yellow instead of red fruits (Table 1, Fig. 3A, B) and its distribution restricted to the lowlands (100–400 m).

Paullinia brentberlinei Croat is known from the tropical lowlands (200–300 m) of northern Peru (Fig. 1). Examination of the type material as well as other collections reveals that this species differs from *P. obovata* subsp. *polymorpha* only by having larger fruits (8–9 cm in subsp. *brentberlinei* vs. 4–7 cm in subsp. *polymorpha*, cf. Table 1). Therefore, this species is transferred to *P. obovata*. It is probably best to accept it as a subspecies of *P. obovata*, as suggested by Beck (1991) in his Ph.D. thesis.

In his partial revision Simpson (1976) recognized in *P. obovata* three varieties: var. *obovata*, var. *polymorpha* D. R. Simpson, and var. *subrotunda* (Ruiz & Pavón) D. R. Simpson. They differ mainly in their size and shape of the fruits (Fig. 2A–C) and some vegetative characters (cf. Table 1). The varieties of *P. obovata* as delimited by Simpson (1976) show a geographical correlation with the main morphological characters and are therefore treated as subspecies (Hamilton & Reichard, 1992). Subspecies *obovata* and subspecies *polymorpha*, both with fusiform and stipitate fruits, differ in fruit size (2.5–4.5 cm in subsp. *obovata* vs. 4–7 cm in subsp. *polymorpha*), serration type and indument of the leaflets (conspicuous, beginning below or above middle; mostly glabrous in subsp. *obovata* vs. inconspicuous, beginning above middle; pubescent beneath in subsp. *polymorpha*, cf. Table 1). Their distribution area is overlapping. Subspecies *obovata* has its main area of distribution between 700 and 1000 m, but may also be found in the lowlands ((200)–400 m), whereas subspecies *polymorpha* is mainly found in the lowlands but reaches elevations of up to 800 m. Subspecies *subrotunda* has obovate, (sub)sessile fruits and is restricted to middle elevations ((700)–1200–1800 m) of the central eastern Andean slopes. Subspecific rank for these taxa also provides more consistency of the infraspecific delimitation within *Paullinia*. Intermediate forms of subspecies of *P. obovata* are occasionally found (e.g., leaf characters pointing to subsp. *obovata* combined with fruit characters typically found in subsp. *polymorpha*).

Paullinia obovata (Ruiz & Pavón) Persoon, Syn. Pl. 1: 443. 1805. Basionym: *Semarillaria obovata* Ruiz & Pavón, Fl. Peruv. Prodr. 54. 1794; Fl. Peruv. IV: 156–157. 1954. TYPE: Peru. Pozuzo [not preserved or destroyed?]. LECTOTYPE (designated here): "*Semarillaria obovata*" [icon no. 338 in] Ruiz & Pavón, Fl. Peruv. IV: 189. 1954.

In the *Flora Peruvianae, et Chilensis Prodromus* 54, Ruiz and Pavón (1794) mentioned the species name *Semarillaria obovata* for the first time. Only a short sentence is given, and neither specimens nor localities are cited. The same authors present in the *Fl. Peruv. IV* (1954), a broader description stating "[*Semarillaria obovata*] habitat in Peruviae Andium nemoribus Pozuzo," but still without a citation of specimens. In his revision Simpson (1976) designated "Ruiz & Pavon s.n. from Pozuzo" as a "fictive type" of *P. obovata*. Photographs (negatives) of lectoparatypes are cited, i.e., F 53208 [53204] and F 23655 (ex G). These photographs show sterile specimens, which contain no original label or note from Ruiz and Pavón, and the corresponding specimen to F 23655 could not be found in Geneva (G). Therefore, these two specimens cannot be linked to the information provided in the protologue. Since Ruiz noted in his journal *Semarillaria*

Table 1. Comparative morphological features of the subspecies of *Paullinia obovata*.

Paullinia obovata		*subsp. obovata*	subsp. *flava*	subsp. *brentberlinei*	subsp. *polymorpha*	subsp. *subrotunda*
Young stem	indument	sparsely pubescent to mostly glabrous	sparsely pubescent to mostly glabrous	pubescent to sparsely pubescent	sparsely pubescent to mostly glabrous	sparsely pubescent
Leaves	petiole length (cm)	3–16 sometimes slightly margined	4–14	12.5–13.5	4.5–15	6–25.5
	rachis length (cm)	2–5.5 sometimes slightly margined	2–5	3–4	1.5–5.0	2–8
Leaflets	length × width (cm)	5–17.5 × 3–9	7.5–21.5 × 4–9.5	8.5–17 × 5.5–9	12.5–19 × 6.5–9.5	7.5–23 × 3.5–9
	petiolule length (cm)	0.2–1.7	0.3–0.8	0.5–1	0.8–1.2	0.5–1.5
	serration	conspicuous, beginning below or above middle	conspicuous, beginning below or above middle	inconspicuous, beginning above middle	inconspicuous, beginning above middle	inconspicuous, beginning above middle
	indument	mostly glabrous on both sides	mostly glabrous on both sides	mostly glabrous above, pubescent beneath	mostly glabrous above, pubescent to sparsely pubescent beneath	mostly glabrous above, pubescent to sparsely pubescent beneath
	2° nerves	7–10, some bifurcating near the margin	9–10, some bifurcating near the margin	7–9, rarely bifurcating near the margin	7–10, rarely bifurcating near the margin	9–10, rarely bifurcating near the margin
	hairtufts (domatia)	inconspicuous to conspicuous, only between 1° and 2° nerves	inconspicuous, only between 1° and 2° nerves	none	inconspicuous, only between 1° and 2° nerves	conspicuous, between 1° and 2° and 2° and 3° nerves
Infructescence	axis length (cm)	8.5–28	11–19	7.5–42	26–29.5	11.5–28.5
	indument	sparsely pubescent to mostly glabrous	sparsely pubescent	pubescent	pubescent	pubescent to sparsely pubescent
Capsules	length (incl. stipe) × width (cm)	2.5–4.5 × 1.5–2.5	3–4 × 2.5–3.5	8–9 × 3.5–5	4–7 × 2–3.5	3.5–4 × 2.5–3.5
	shape	fusiform to obovate and stipitate	fusiform to obovate and stipitate	fusiform and stipitate	fusiform and stipitate	obovate and subsessile
	color when mature	red	yellow with red dehiscence lines	red	red	red
Distribution	area (mainly Peru, cf. Fig. 1)	eastern Andean slopes and tropical lowland	tropical lowland	tropical lowland of northern Peru	eastern Andean slopes and tropical lowland	central eastern Andean slopes
	altitude	(200–)400–1000 m	100–400 m	200–300 m	400–800 m	(700–)1200–1800 m

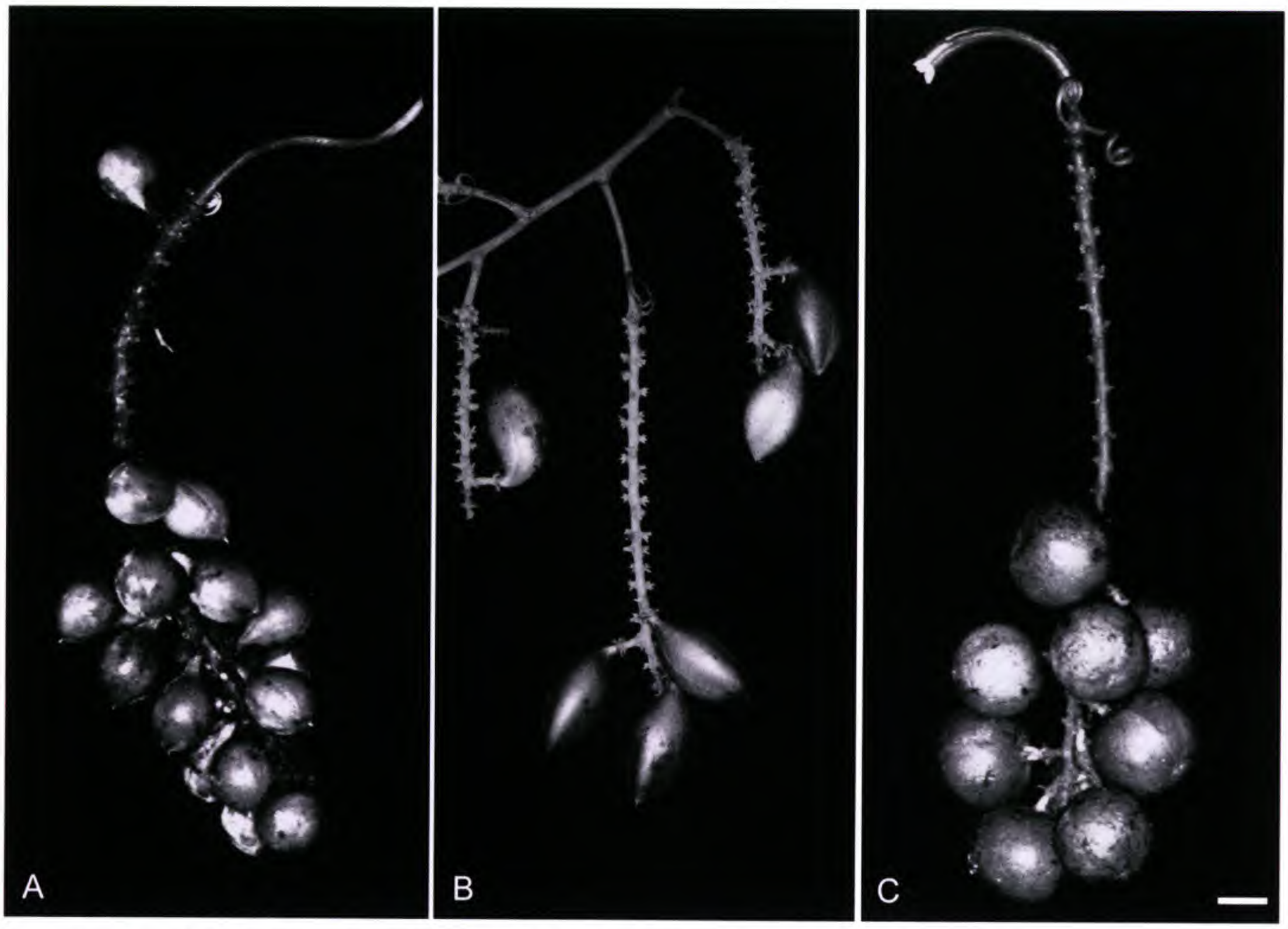

Figure 2. Typical fruit shapes in subspecies of *Paullinia obovata*. —A. *Paullinia obovata* subsp. *obovata*, *Weckerle & Igersheim 000330–2/1* (MOL). —B. *Paullinia obovata* subsp. *polymorpha*, *Weckerle & Igersheim 010202–1/2* (MOL). —C. *Paullinia obovata* subsp. *subrotunda*, *Weckerle & Igersheim 000329–1/1* (MOL). Scale bar 2 cm.

obovata among those species he "succeeded in describing in Huánuco, of those that were worked on in Macora and that were burned in that fire" (as cited in Ruiz, [1777–1788] 1940: 203), it can be expected that the set of collections made by Ruiz and Pavón and used for their description and illustration prepared in Peru (Lack, 1979) was destroyed. There is no doubt about the good quality of the illustration that accompanies Ruiz and Pavón's (1954) description of the species in *Fl. Peruv. IV.* It agrees unambiguously with the taxon as understood by us and shows clearly, besides leaf characters, the pertinent fruit characters. The illustration given by Ruiz and Pavón (1954) is therefore designated herewith as the lectotype of *Paullinia obovata* (Ruiz & Pavón) Persoon.

1. Paullinia obovata (Ruiz & Pavón) Persoon subsp. **obovata**

Distribution and habitat. *Paullinia obovata* subsp. *obovata* is a rather widespread taxon and occurs mainly in the forests of the eastern Andean slopes between 700 and 1000 m, but may also be found in the lowlands ((200)–400 m) of Junín, Pasco, San Martín, and Ucayali, along rivers, edges of secondary forests, and along roadsides (Fig. 1).

Phenology. Flowering specimens were collected during October and January and specimens with mature and immature fruits during January, March, April, May, July, and October.

Discussion. Vegetatively, *Paullinia obovata* subsp. *obovata* is very similar to *P. obovata* subsp. *flava*, and both taxa seem to be closely related. In both subspecies the serration of the margins of the leaflets begins below or above the middle, and the lower surface of the leaflets is mostly glabrous (Table 1). The two subspecies differ markedly in the color of the capsules at maturity (red in subsp. *obovata* vs. yellow in subsp. *flava*, cf. Fig. 3A, B and C–E), and in contrast to subspecies *flava*, which is restricted to the lowlands, subspecies *obovata* occurs mainly in the eastern Andean slopes (Fig. 1).

Specimens examined. PERU. No locality given: *Pavón 644* (G), *Pavón 1821* (G), *Pavón s.n.* (G). **San Martín:** Mariscal Cáceres, Tocache Nuevo, Fundo Miramar, "en bosque alto," 28 Mar. 1970, *Schunke 3879* (G, MO, MOL); "al borde del Río en bosque alto," 1 July 1974, *Schunke 7091* (G, MO, USM); Fundo Miramar, "en bosque alto,"

10 Oct. 1980, *Schunke 12338* (USM, Z), *Schunke 13388* (USM, Z). **Ucayali:** Coronell Portillo, Pucallpa, Río Pachitea, 30 Jan. 1988, *Ayala 6002* (MO); Leoncio Prado (Yarinacocha), 15 May 1984, *Vásquez 5004* (MO); Previsto, on the bank of stream, 10 Oct. 1962, *Woytkowski 7573* (MO). **Junín:** Puente Paucartambo, 30 Mar. 2000, *Weckerle & Igersheim 000330–2/1* (MOL); Perené, road between Perené and La Esperanza, 4 Apr. 2000, *Weckerle & Igersheim 000404–1/5* (MOL); riverside of Río Paucartambo, near Puente Colgante along road to Perené, 19 July 2000, *Weckerle & Igersheim 000719–1/2* (MOL); La Merced, road between Puente Colorado and Casa Blanca, 5 Apr. 2000, *Weckerle & Igersheim 000405–1/4* (MOL), 710 m, 3 July 2000, *Weckerle & Igersheim 000703–2/1* (MOL); road between Puente Colorado and La Alianza, 3 July 2000, *Weckerle & Igersheim 000703–1/2* (MOL); road along Quebrada Pescarola, 10 July 2000, *Weckerle & Igersheim 000710–1/6* (MOL); Puente Quimiri, riverside of Río Chanchamayo near confluence with Quebrada Sheila, 18 July 2000, *Weckerle & Igersheim 000718–2/1* (MOL); Villa Rica, road between Cedro Pampa and Purús, riverside of Quebrada Aqua Blanca, ca. 7 July 2000, *Weckerle & Igersheim 000707–2/1* (MOL); San Ramon, road between Puente Victoria and Lourdes, along Quebrada Oxabamba, 11 July 2000, *Weckerle & Igersheim 000711–1/2* (MOL); road between Puente Victoria and Lourdes, along Quebrada Oxabamba, 11 July 2000, *Weckerle & Igersheim 000711–1/6* (MOL); riverside between Puente Victoria and Puente Almandra, 15 Jan. 2001, *Weckerle & Igersheim 010115–1/2* (MOL).

2. Paullinia obovata subsp. **flava** Weckerle & Igersheim, subsp. nov. TYPE: Peru. Loreto: Maynas, Requena, ca. 7 km W of Jenaro Herrera, vicinity of Laguna Vainilla, inundated primary forest (Braga), 04°54′46″S, 73°44′20″W, ca. 110 m, 27 May 2000, *A. Vásquez, C. S. Weckerle & A. Igersheim 000527–1/4* (holotype, MOL; isotype, Z). Figure 3A, B.

Ab aliis subspeciebus capsulis flavis cum lineis dehiscentiae rubris differt.

Liana, stems sparsely pubescent to mostly glabrous, stem with a single stele, up to 8–9 cm diam. Leaves pinnately 5-foliolate, petiole and rachis wingless, petiole 4–14 cm, rachis 2–5 cm, stipules subulate, deciduous. Petiolule 0.3–0.8 cm, leaflets chartaceous, ovate, elliptic to obovate, 7.5–21.5 cm long (including the petiolule), 4–9.5 cm wide, the apex acuminate, the base acute, obtuse to rounded, margins with serration beginning above or below middle, never at base, mostly glabrous except for the hair tufts in the axils between primary and secondary nerves, some secondary nerves bifurcating near the margin. Infructescence 11–19 cm long, rachis rusty tomentose, bracts deciduous. Fruits stipitate or subsessile, fusiform to obovate, 3–4 cm long (including the 0.3–0.5 cm long stipe), 2.5–3.5 cm wide, yellow when mature with three red dehiscence lines, the valves fibrous, with fibers running longitudinally, the three septa usually persistent; seeds dark brown or black, characteristically covered by a white aril.

Distribution and habitat. *Paullinia obovata* subsp. *flava* is restricted to lowland rain forests along river margins or seasonally inundated areas at elevations from 100 to 400 m (Fig. 1).

Phenology. The two specimens examined with buds were collected in October and November. The remaining specimens show young and mature fruits. They have been collected in January, March, May, and June, respectively.

Discussion. Herbarium material of *Paullinia obovata* subsp. *flava* is very similar to that of subspecies *obovata* (fruit size and shape, serration type and indument of leaflets) and therefore sometimes difficult to distinguish. The diagnostic feature for subspecies *flava*, the yellow color of the capsules with the three red dehiscence lines, cannot be seen directly on the dried herbarium specimen. However, after drying, the capsules of subspecies *flava* appear to be more orange-colored than the capsules of all other subspecies of *Paullinia obovata*, which are brown. Thus, notes on the labels concerning the color of mature fruits at their time of collection are important for identification.

Paratypes. PERU. **Loreto:** Maynas, Requena, along Quebrada Caño Iricahua near the confluence with Río Ucayali, 31 May 2000, *Vásquez, Weckerle & Igersheim 000531–1/6* (MOL); Reserva Nacional Pacaya Samiria, Sitaraco, 29 Mar. 1993, *del Carpio 1977* (USM); Campamento La Huaca, 9 June 1993, *del Carpio 2448* (USM); Alto Amazonas, Río Pastaza, "una hora arriba de la boca del Lago Rimachi," 25 Jan. 1979, *Diaz & Ruiz 914* (MO). **Madre de Dios:** Manu, vicinity of Cocha Cashu Station, 7 Mar. 1977, *Bell & Foster 6192* (USM); moist floodplain forest, lake edge, 2 Oct. 1991, *Burnham RJB691* (USM); Cocha Juarez, Río Manu, 3–5 May 1987, *Núñez, Lees & Wright 8027* (USM); vicinity of Cocha Cashu Station, lake margin, 3 Nov. 1976, *Terborgh 5185* (USM).

3. Paullinia obovata subsp. **brentberlinei** (Croat) Weckerle & H. T. Beck, stat. nov. Basionym: *Paullinia brentberlinei* Croat, Phytologia 38: 73–74. 1977. TYPE: Peru. Amazonas: Quebrada Huampami, 10 km from its mouth at the Río Cenepa, 700 ft. [ca. 200 m], 23 Nov. 1972, *B. Berlin 336* (holotype, MO; isotypes, USM, US not seen).

Distribution and habitat. *Paullinia obovata* subsp. *brentberlinei* is only known from the lowland forest of northern Peru (200–300 m). It occurs mainly in the department Amazonas along riversides and in inundated areas (Fig. 1).

Phenology. No flowering specimens were ex-

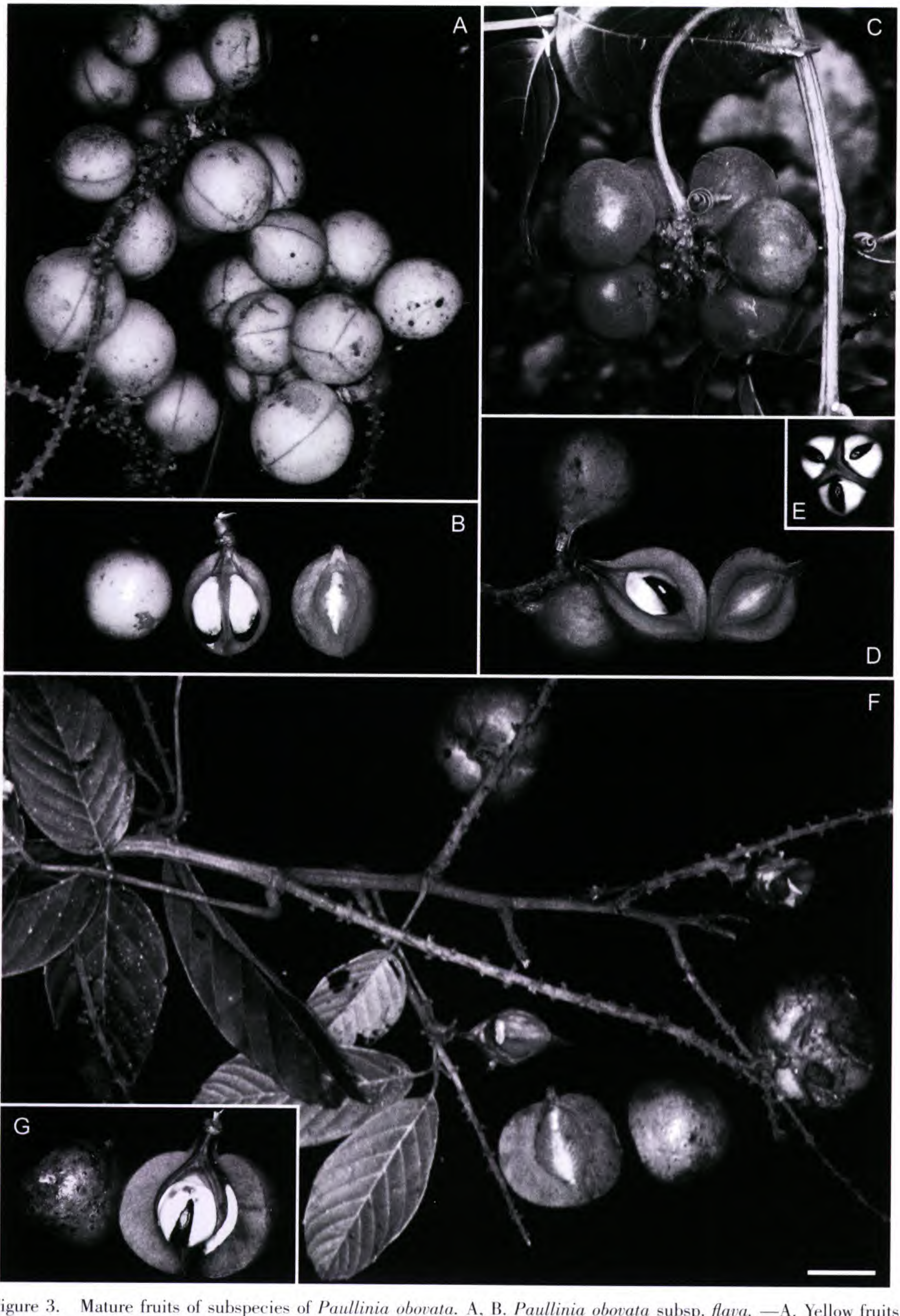

Figure 3. Mature fruits of subspecies of *Paullinia obovata*. A, B. *Paullinia obovata* subsp. *flava*. —A. Yellow fruits from the type collection plant. —B. Fruit revealing seeds with aril. C–E. *Paullinia obovata* subsp. *obovata*. —C. Red fruits. —D. Fruit revealing seeds with aril. —E. [Inset] Persistent septa with arillate seeds. F, G. *Paullinia obovata* subsp. *subrotunda*. —F. Red fruits. —G. [Inset] Fruit revealing seeds with aril. A, B are from *Vásquez, Weckerle &*

amined. Fruiting specimens were collected during November, January, March, and May.

Discussion. Examination of the type material of *Paullinia brentberlinei* as well as other collections reveals that this species only differs from *P. obovata* subsp. *polymorpha* by having larger fruits (8–9 cm in subsp. *brentberlinei* vs. 4–7 cm in subsp. *polymorpha*). The vegetative features are the same as in subspecies *polymorpha,* i.e., the inconspicuous serration of the leaflets begins above the middle and the leaflets are pubescent beneath with inconspicuous hair tufts (Table 1).

Specimens examined. PERU. **Amazonas:** Quebrada Huampami, Río Cenepa, 26 May 1973, *Kayap 818* (USM); Quebrada Huampami, monte al lado de Huampami, 20 Jan. 1973, *Kayap 189* (USM); Yamayakat, bosque de ribera, 13 Mar. 1996, *Jaramillo, Jaramillo & Chamit 1383* (USM); Bagua, Imaza-Chipe, bosque de ribera del Marañon, 28 May 1996, *Vásquez et al. 21026* (USM).

4. Paullinia obovata subsp. **polymorpha** (D. R. Simpson) Weckerle, stat. nov. Basionym: *Paullinia obovata* var. *polymorpha* D. R. Simpson, Fieldiana 36: 155. 1976. TYPE: Peru. San Martín: Mariscal Caceres, Tocache Nuevo, "bosque alto," Quebrada de Tananta, 17 Dec. 1970, *J. Schunke 4580* (holotype, F not seen; isotypes, G, MOL).

Distribution and habitat. Paullinia obovata subsp. *polymorpha* is found in the tropical lowland and the foothills of the Andes at 400–800 m (Fig. 1).

Phenology. Flowering specimens were collected during February and specimens with mature and immature fruits during December, February, and April.

Discussion. Simpson (1976) chose *Schunke 4580* as the type specimen for *P. obovata* subsp. *polymorpha.* However, this specimen does not represent the typical character set of subspecies *polymorpha.* The leaves point much more to subspecies *obovata* (serration conspicuous, beginning below middle) than to subspecies *polymorpha,* and the fruits of the specimen, which bear the most important characters for infraspecific delimitation, are immature. More representative material of subspecies *polymorpha* can be seen on *Schunke 4574,* for the vegetative, and *Smith 1234,* for the fruit characters.

Specimens examined. PERU. **San Martín:** Mariscal Caceres, Tocache Nuevo, "bosque alto," Quebrada de Tananta, 17 Dec. 1970, *Schunke 4574* (G). **Huánuco:** Pachitea, Comunidad Nativas Santa Marta, about 50 km by river from Puerto Inca, on bank of Sungaruyacu, 11 Apr. 1982, *Smith 1234* (AMAZ, MO, MOL, USM); Pozuzo, road between Pozuzo and Santa Rosa, 2 Feb. 2001, *Weckerle & Igersheim 010202–1/1* (MOL), *Weckerle & Igersheim 010202–1/2* (MOL).

5. Paullinia obovata subsp. **subrotunda** (Ruiz & Pavón) Weckerle, stat. nov. Basionym: *Semarillaria subrotunda* Ruiz & Pavón, Fl. Peruv. Prodr. 54. 1794. *Paullinia subrotunda* (Ruiz & Pavón) Persoon, Syn. Pl. 1: 443, no. 15. 1805. *Paullinia obovata* var. *subrotunda* (Ruiz & Pavón) D. R. Simpson, Fieldiana 36(12): 153–154. 1976. TYPE: Peru. No locality given: *H. Ruiz s.n.* [*J. Tafalla s.n.*] (lectotype, designated by Simpson (1976), MA not seen; isolectotype, US).

Distribution and habitat. It is only known from the central eastern Andean slopes of Peru, occurring between (700–)1200 and 1800 m in the departments of Junín, Pasco, and Huánuco, in secondary forests, along roads and riversides (Fig. 1).

Phenology. Flowering specimens were collected during December and January and specimens with mature and immature fruits during March and April.

Discussion. The type collection for *Paullinia obovata* subsp. *subrotunda* (*Ruiz s.n.* [*Tafalla s.n.*]) was probably collected by Tafalla and sent to Ruiz. Details supporting this were discussed by Simpson (1976: 154).

Paullinia obovata subsp. *subrotunda* differs from all other subspecies by its broader fruits, somewhat resembling walnuts when green, and by the broader seeds and thicker fruit walls. Unlike the lectotype, which bears no fruits, the icon 336 in *Fl. Peruv. IV* is a very good reference for this subspecies.

Specimens examined. PERU. **Pasco:** Oxapampa, Villa Rica–Yesú road, 28–29 Dec. 1983, *Smith, Brack & Meza 5427* (MO); Oxapampa, roadside between Pusapno and Oxapampa, 18 Mar. 2000, *Weckerle & Igersheim 000318–3/1* (MOL); Oxapampa, Pusapno, 15 Mar. 2000, *Weckerle & Igersheim 000315–2/1* (MOL), 14 Apr. 2000, *Weckerle & Igersheim 000414–1/4* (MOL), 28 Jan. 2001, *Weckerle & Igersheim 010128–1/1* (MOL); Pusapno, along Río Pusapno, 16 Mar. 2000, *Weckerle & Igersheim 000316–2/1* (MOL). **Junín**: Villa Rica, along road to Ocanal, edge of

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Igersheim 000527–1/4 (MOL, Z); C and E from *Weckerle & Igersheim 000405–1/4* (MOL); D from *Weckerle & Igersheim 000703–2/1* (MOL); F from *Weckerle & Igersheim 000315–2/1* (MOL); and G from *Weckerle & Igersheim 000318–3/1* (MOL). Scale bar 2 cm. Photographs by C. Weckerle & A. Igersheim.

"Laguna," 29 Mar. 2000, *Weckerle & Igersheim 000329–1/1* (MOL), 7 July 2000, *Weckerle & Igersheim 000707–1/1* (MOL). **Huánuco:** Tingo Maria, 22 June 2000, *Weckerle & Igersheim 000622–1/2* (MOL).

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A New Species of *Ephedra* (Ephedraceae) from China

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ABSTRACT. A new species, *Ephedra rituensis* Y. Yang, D. Z. Fu & G. Zhu, is described and illustrated. This species is similar to *Ephedra intermedia* Schrenk & C. A. Meyer in having bi- or tri-ovulate cones, and to *E. saxatilis* Royle ex Florin in having strong and well-developed woody stems and branchlets. It differs from *E. intermedia* mainly by the shorter micropylar tube straight or slightly curved and the less connate bracts of the uppermost whorl of female cones, and from *E. saxatilis* by the longer micropylar tube, the bi- or tri-ovulate female cones, more pairs or whorls of bracts, and the smaller seeds. The new species should be ascribed to *Ephedra* sect. *Pseudobaccatae* Stapf since its female cones bear fleshy bracts at maturity.

Key words: China, *Ephedra*, *Ephedra* sect. *Pseudobaccatae*, Ephedraceae.

Ephedra rituensis Y. Yang, D. Z. Fu & G. Zhu, sp. nov. TYPE: China. Xizang: Rutog Xian, 4600 m, (♀) 30 July 1974, *Xizang Exped. 3676* (holotype, HNWP; isotypes, PE, XJBI). Figure 1.

Haec species ad *Ephedram intermediam* et *E. saxatilem* maxime accedit, sed a hac strobilo foemineo bi- vel tri-ovulato bractearum paribus verticillisve multioribus munito, seminibus minoribus atque micropyles tubo longiore, ab illa micropyles tubo breviore recto vel leviter curvata distinguitur.

Dioecious subshrub, erect, to 50 cm tall, major stems lignified and woody, erect or procumbent, fawn-colored, sometimes ash-gray, up to 6 mm diam., ascendingly branched; branchlets stout, erect or suberect, yellowish green, flat at beginning, slightly warty when elderly, solitary, opposite or fasciculate, 1.8–2.9 mm diam., purplish brown medullated; internodes longitudinally striate, 1.4–3.9 cm long, 1.3–2.9 mm diam. Leaves white, membranous, 3–4 mm long, 2 or 3 at nodes, with 2 purplish brown veins in middle part, connate for 2/3–4/5 of total length, fused sheath cylindric, apices triangular, acute or acuminate, not recurved. Male cones sessile, solitary or opposite, 4–6 mm long, ovoid; bracts in 3 to 4 pairs, ovate, obtuse; synangia 6 to 8, sessile, densely aggregated on top of column. Female cones sessile, solitary, opposite or clustered, 5–7 mm long, 2.8–4 mm diam.; bracts in 4 or 5 pairs or whorls, those of uppermost whorl broadly ovate, apex obtuse, connate for 1/3–1/2 their length, red and fleshy at maturity, other whorls of bracts smaller and distinct from each other. Seeds 2 or 3, concealed by bracts, purplish brown, ovoid, ca. 5 mm long, ca. 3 mm wide, smooth, dorsally convex and ventrally plane, or carinate; micropylar tube straight or slightly curved, ca. 2.2 mm long, exserted.

Etymology. The specific epithet is derived from Chinese ping-yin of the county where the holotype of *Ephedra rituensis* was collected.

Distribution. *Ephedra rituensis* is found in some inaccessible localities of the Tibetan Plateau. Most specimens examined were collected from Xizang, China, but a few were found in Yecheng of southern Xinjiang and Qinghaihu of Qinghai, China.

Habitat. Newly described *Ephedra rituensis* grows in slightly divergent habitats at 3200–4600 m. The holotype was found in a dried river beach at 4600 m; other examined specimens were discovered in crevices of rocks, sand dunes, or dried gravel river beaches at 3200–4270 m. This species may live in a relatively moist condition since most specimens were collected near a river or lake.

Relationships. This new species is similar to *Ephedra intermedia* in having bi- or tri-ovulate cones, and to *E. saxatilis* in having strong and well-developed woody stems and branchlets. It differs from *E. intermedia* mainly by its shorter micropylar tube straight or slightly curved, the less connate bracts of the uppermost whorl, and the narrower female cones, and from *E. saxatilis* by its longer micropylar tube, bi- or tri-ovulate female cones,

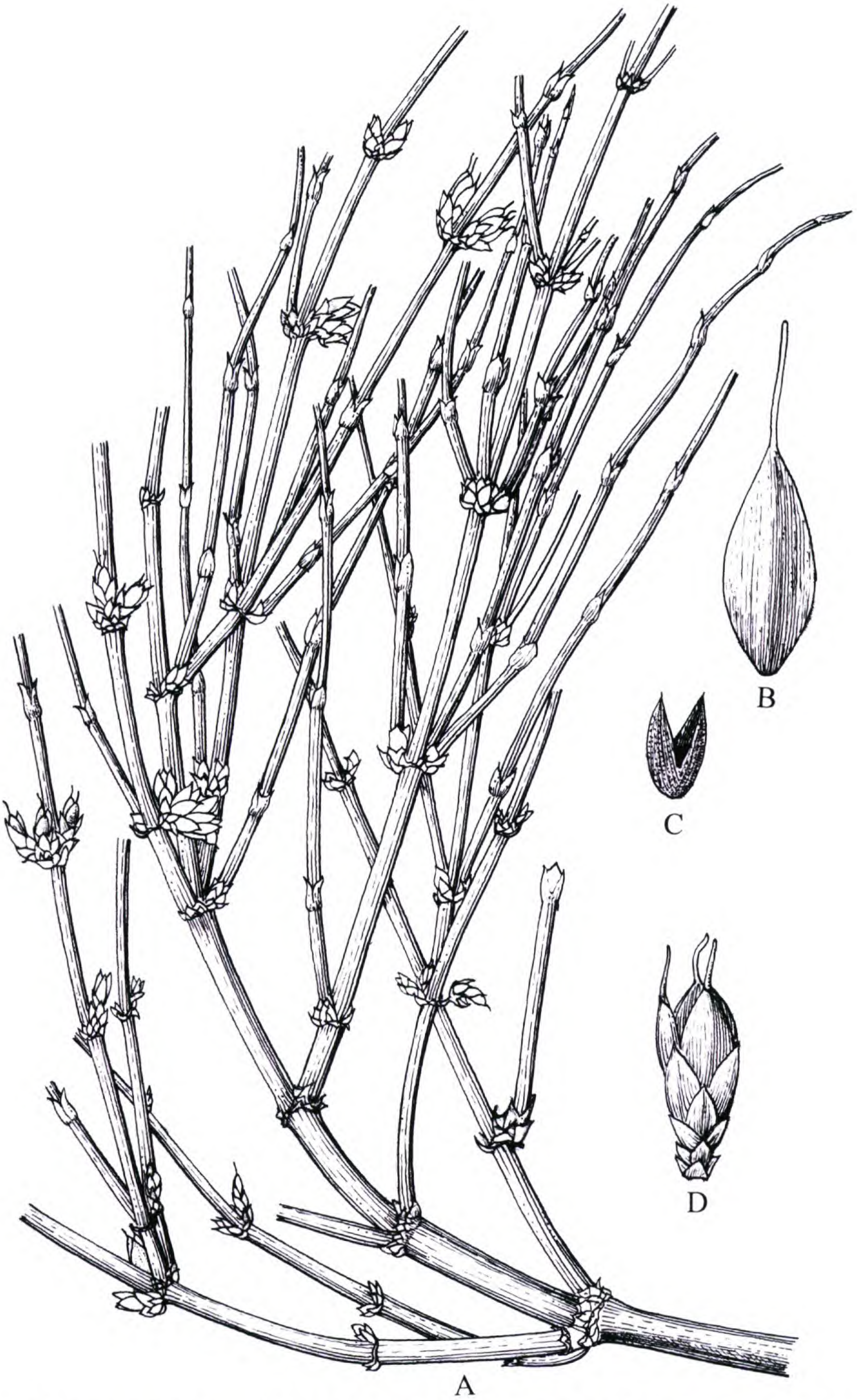

Figure 1. *Ephedra rituensis* Y. Yang, D. Z. Fu & G. Zhu (holotype). —A. Habit, female plant, ×1. —B. Seed, ×6. —C. The uppermost whorl of bracts to show the degree of fusion, ×2. —D. Female cone, ×3.

smaller seeds, and more pairs or whorls of bracts of female cones (Meyer, 1846; Stapf, 1889; Florin, 1933; Fu et al., 1999).

The most widely used sectional classification of *Ephedra* was made by Stapf (1889) based on the nature of bracts of female cones, although there are different opinions (Soskov, 1968; Pachomova, 1971; Mussayev, 1978). Bracts of female cones in *Ephedra* at maturity may be fleshy, coriaceous, or membranous, representing section *Pseudobaccatae*, section *Asarca*, and section *Alatae*, respectively (Stapf, 1889). This newly described species clearly belongs to *Ephedra* sect. *Pseudobaccatae*.

Paratypes. CHINA. **Xizang:** Burang Xian, (♀) 18 Aug. 1974, *Tibet Exped. 3999* (HNWP, XJBI); Burang Xian, (♂), *Vegetation Group, Qianghai-Xizang Exped. 13006* (PE); Rutog Xian, (♀) 14 Sep. 1976, *Vegetation Group, Qinghai-Xizang Exped. 13665* (PE); Gyirong Xian, (♀) 30 July 1975, *Wu C. Y., Chen S. K., Du Q. & Lu S. L. 75–493* (PE); Zhag'yab Xian, (♀) 1 Sep. 1976, *Qingzang Exped. 12981* (PE). **Xinjiang:** Yecheng, (♀) 23 Aug. 1987, *Wu Y. H. 1172* (PE). **Qinghai:** Qinghaihu, 1 July 1958, *Tsoong Pu-Chiu 8329* (PE).

Acknowledgments. We thank Helmut Freitag, Roy Gereau, and Maria Maier-Stolte for their valuable comments, and Yingbao Sun for preparing the illustration. We are grateful to the curators of HNWP, PE, and XJBI for the loans of specimens. This paper is supported by Project Ksxc2-sw-108 (Chinese Academy of Sciences).

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Rhododendron maxiongense (Ericaceae), a New Species from Yunnan, China

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ABSTRACT. *Rhododendron maxiongense* C.-Q. Zhang & D. Paterson (Ericaceae), from Yunnan, China, is described as new. It is similar to *R. aberconwayi* Cowan, which has elliptical thick and coriaceous leaves with recurved margins that are not undulate and have red punctate hair. The calyx of *R. aberconwayi* is sparsely hairy and glandular-ciliate; the corolla is open-campanulate, white to pale rose, with purple flecks; the pedicels are sparsely hairy and stipitate-glandular; and there is pilus on the base of the stamen. *Rhododendron maxiongense* differs from *R. aberconwayi* in its habitat as a dwarf shrub 0.6 to 0.9 m in height; leaves with undulated recurved margins without red punctate hair; inflorescence 8- to 13-flowered; corolla white, without flecks, apex pale green or pale rose, and lobe apex acute; stamens glabrous; calyx densely hairy; and pedicels densely hairy.

Key words: China, Ericaceae, *Rhododendron*, Yunnan.

Rhododendron L. is a large genus of the Ericaceae containing approximately 960 species worldwide, of which about 542 species (not including subspecies and varieties) are distributed in the wild in western China (Fang, 1999), with 227 species in Yunnan (Fang, 1999) (Cullen, 1980; Chamberlain, 1982; Mei & Fang, 1986). H. Sleumer divided the genus into 8 subgenera, but J. Cullen and D. F. Chamberlain divided it into 5 subgenera.

When investigating plants of *Rhododendron* in Maxiongshan, northeast Yunnan, southwest China, in May 2000, some specimens were collected and all but one was identified. After studying the unidentified specimen and literature, and checking other specimens deposited in KUN, we believe it represents a new species within subsection *Irrorata* of subgenus *Hymenanthes*. Subsection *Irrorata* contains 21 species in China, of which 16 are found in Yunnan (Hu & Fang, 1994; Chamberlain, 1982).

Rhododendron maxiongense C.-Q. Zhang & D. Paterson, sp. nov. TYPE: China. Yunnan: Zhanyi Maxiongshan, 25°35′N, 103°50′E, 2440 m, 6 May 2001, *C.-Q. Zhang 2001–01* (holotype, KUN). Figure 1.

Species affinis *R. aberconwayi*, sed pumilo frutice 0.6–0.9 m, foliis rubris puncticulosis trichomatibus carentibus, inflorescentiis 8–13-floris, purpureis punctis carentibus, apice viridi-albo vel rubello, calyce velato confertim pilis, staminibus glabrescentibus, differt.

Dwarf shrub 0.6–0.9 m high; young shoots sparsely tomentose or glandular, bark glabrous, leaves clustering at the end of shoots; leaf blades elliptic or ovate-elliptic, thick and coriaceous, 3–6 × 1.2–2.5 cm, apex acute or mucronate, base nearly rounded, margin undulate and recurved; upper blade surface green, glabrous, lower blade surface pale green; midrib strongly sunken above and raised beneath, lateral veins in 10 to 13 pairs, sunken on upper surface and raised beneath; blade petioles 0.7–1 cm, grooved above, with densely glandular hair; racemose umbellate inflorescences 8- to 13-flowered, rachis ca. 1–2 cm with white trichomes; pedicels 0.8–2 cm, with densely white glandular trichomes; calyx lobes 5, triangular, 1–2 mm, densely hairy, glandular-ciliate. Corolla open-campanulate, 1.5–2 cm long, diameter at mouth 2–4.5 cm, lacking nectar pouches, glabrous within, white, without dots, apex pale green or pale rose; corolla lobes 5, apex acute, 1–1.2 × 1.4–1.6 cm; stamens 10, glabrous, anthers long-rounded, ca. 2 mm long, ovary conical, ca. 3.5 × 3 mm, densely glandular, style shorter than corolla, 1.3–1.7 cm long, glandular throughout, stigma pale green or pale rose, capsule unseen.

Distribution. Rhododendron maxiongense is

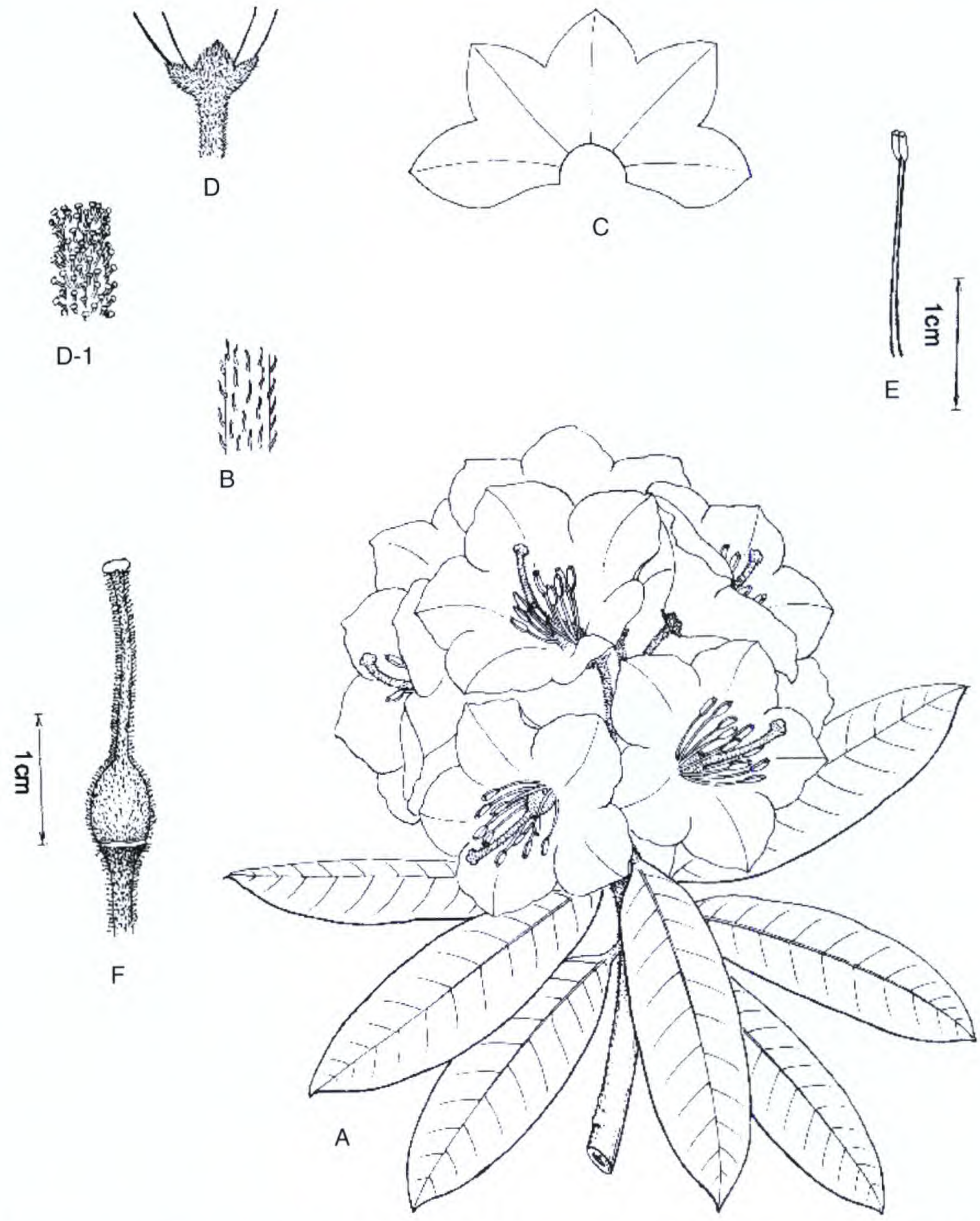

Figure 1. *Rhododendron maxiongense* C.-Q. Zhang & D. Paterson. —A. Inflorescence. —B. Petiole showing setose glandular hair. —C. Acute apex of corolla lobes. —D. Pedicel and calyx hair. —D-1. Pedicel glandular hair. —E. Stamen. —F. Gynoecium. All drawn from the type collection, *C. Q. Zhang 2001–01*, by Yang jian-kun.

known only from Zhanyi County, northeast Yunnan, China. This species grows on slopes of open *Pinus yunnanensis* Franchet var. *pygmaea* (J. R. Xue) J. R. Xue forests at 2440 m above sea level.

Rhododendron maxiongense resembles *R. aberconwayi*: both are evergreen shrubs with open-campanulate flowers, from northwest Yunnan, China. However, the latter species differs in its larger habit (1.5 to 2.5 m high); inflorescence with 6 to 12 flowers, and its corolla with purple flecks inside and emarginated lobes; the base of the stamen has pilus.

Morphologically, *Rhododendron maxiongense*, *R. aberconwayi*, and 17 other species including *R. irrorata* Franchet and *R. agastum* Balfour f. & W. W. Smith all belong to subsection *Irrorata*. These are shrubs or small trees; bark rough; young shoots stipitate-glandular; leaves ovate to elliptic or oblong, lower surface usually glabrous when mature but with persistent punctate base with a thin veil of dendroid hairs embedded in a surface film; inflorescence lax or dense, 4- to 20-flowered; rhachis 5–10(–35) mm, calyx minute or cupular, with broad lobes and up to 6 mm long. Corolla 5- to 7-lobed, tubular to open-campanulate, with or without nectar pouches, white (rarely yellow) to mauve or deep

crimson, usually with darker flecks and stipitate-glandular; style glabrous or glandular to tip (Sleumer, 1949). This subsection comprises about 21 species in China, 16 in Yunnan (Hu & Fang, 1994; Chamberlain, 1982).

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Erratum

Crandall-Stotler, B. J., R. E. Stotler & C. H. Ford. 2002. Contributions toward a monograph of *Petalophyllum* (Marchantiophyta). Novon 12: 334–337.

We thank R. Grolle (JE) for calling to our attention the misspelling of *Petalophyllum hodgsonii* sp. nov. (p. 336). In accordance with Article 60.11 of ICBN, the termination of the epithet "*hodgsonii*" should be corrected to "*hodgsoniae*."

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Chromosome Cytology and Taxonomy of the Red Goblet-Flowered Species of *Clidemia* (Melastomataceae: Miconieae) in Central and South America

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ABSTRACT. *Clidemia clandestina* (Melastomataceae) of Costa Rica and Panama is newly described as part of a review of the goblet-flowered species from tropical America. This natural group of three species, including *C. garciabarrigae* and *C. utleyana*, is characterized by 5-merous flowers that are goblet-shaped in profile view with erect red petals that are connivent and cucullate at anthesis, minute anther thecae with wide ventrally inclined apical pores, and a completely inferior 3-locular ovary. An original chromosome count of n = 17 is reported for *C. utleyana*, and a count of n = 23 is reported for *C. clandestina* and *C. garciabarrigae*. The significance of these chromosome numbers is evaluated in the context of previous reports for the tribe Miconieae together with a diagnostic key, descriptions, illustrations, new distributional information, phenological notes, and citations of representative specimens.

Key words: Central America, chromosome cytology, *Clidemia*, Melastomataceae, Miconieae, red goblet-flowered species, South America.

Clidemia D. Don sensu lato, a berry-fruited genus of Melastomataceae with over 170 species, is diverse and widespread in the American tropics but still little-known and undercollected in several parts of its range. The three species treated here are collectively distributed from Costa Rica and Panama disjunctly south to Colombia and northwestern Ecuador where they occur in some of the wettest environments of the two contiguous biodiversity hot spots in the region (Mittermeier et al., 1999). They constitute a distinctive assemblage characterized by their scandent or reclining (sometimes epiphytic) habit, completely inferior 3-locular ovary, 5-merous flowers that are goblet-shaped in profile view (Figs. 2D, 3D) with unusual red petals that are erect, connivent, and conspicuously concave at anthesis (Figs. 2E, 3H). In addition, the anther thecae are minute, incurved, and have comparatively wide ventrally inclined apical pores. A taxonomic account of this species group is presented to facilitate the description of *C. clandestina* from Costa Rica and Panama and to provide the first chromosome information for each of the three species.

CHROMOSOME CYTOLOGY

The first gametic chromosome number reports are presented here for one population each of *C. clandestina*, *C. garciabarrigae*, and *C. utleyana*. Although some pollen mother cells of both *C. clandestina* and *C. garciabarrigae* showed some lagging chromosomes, meiosis for the most part appeared to be regular with n = 23 for the few cells examined (Fig. 1A–1C). In *C. utleyana* meiosis was consistently regular with n = 17 in all cells examined (Fig. 1D). Bud material for these counts was collected from natural populations in the field, fixed in modified Carnoy's solution (4 chloroform, 3 ethanol, 1 glacial acetic acid, v/v/v, Bradley, 1948), transferred to 70% ethanol, and stored under refrigeration. All counts were made with a Zeiss light

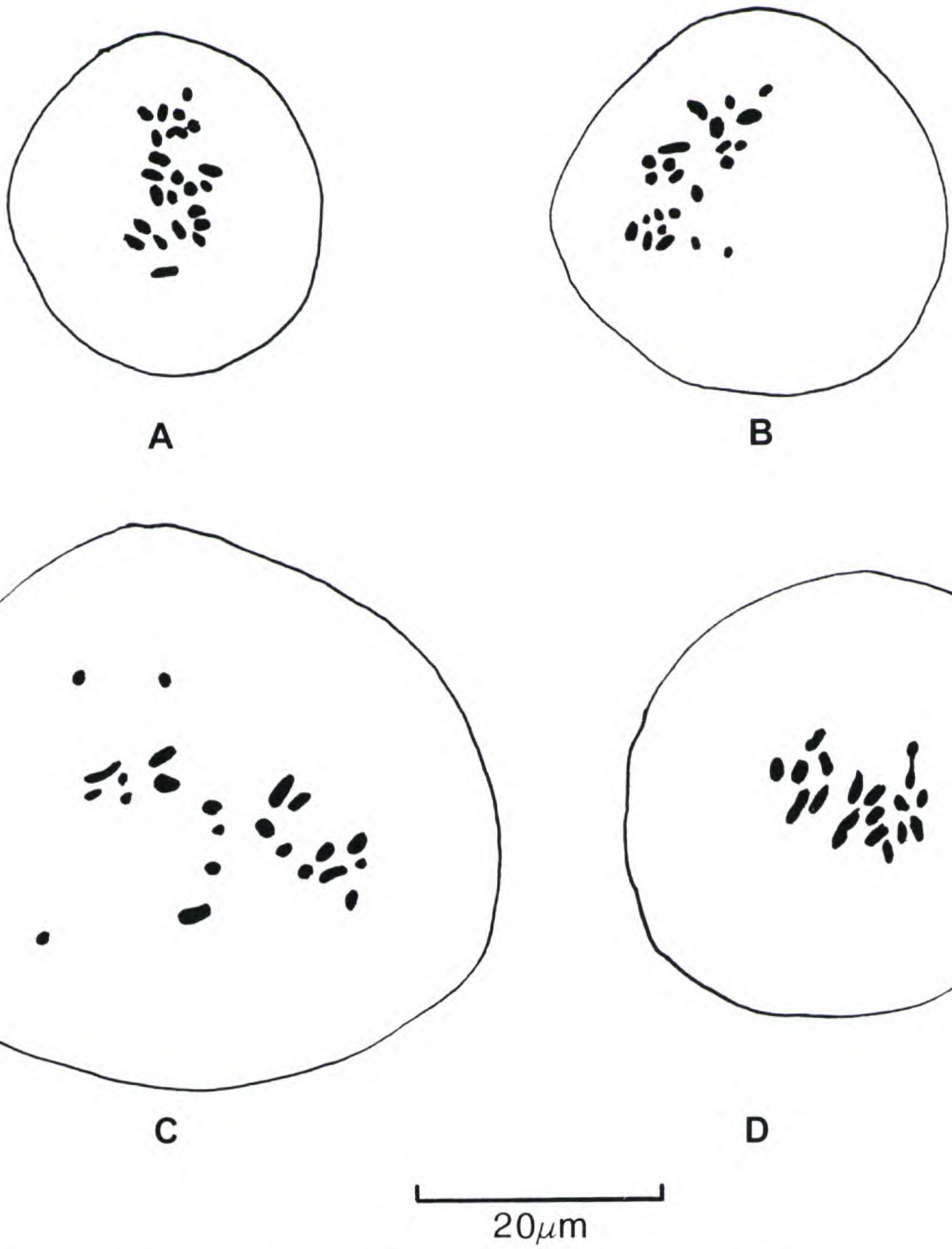

Figure 1. Camera lucida drawings of meiotic chromosome figures of *Clidemia*.—A, B. *C. clandestina*, n = 23, metaphase I (*Almeda et al. 5907*). —C. *C. garciabarrigae*, n = 23, metaphase I (*Almeda et al. 7504*). —D. *C. utleyana*, n = 17, metaphase I (*Almeda et al. 6864*).

microscope with phase contrast and a 100× oil immersion objective. Drawings of meiotic figures were made with camera lucida at a magnification of 2100×. Voucher collections for the counts reported here are marked with an asterisk among the specimens cited.

The count of n = 17, reported here for *C. utleyana*, is the most commonly reported gametic chromosome number in the tribe Miconieae and appears to be the base number for *Clidemia* and several related genera (Almeda & Chuang, 1992; Solt & Wurdack, 1980). Ten of the 14 genera in the Miconieae investigated to date have $x = 17$ and the other four genera have n = 15, 20, 28, and other numbers that can best be interpreted as dysploid derivatives of polyploid numbers (Almeda, 1997a). Almeda and Chuang (1992) speculated that n = 17 may have arisen as a dysploid derivative of an autotetraploid based on $x = 9$ or by ancient hybridization of species with 7 and 10 or 8 and 9 haploid chromosome numbers. Because chromosome numbers ranging from $x = 9$ through $x = 12$ are known for several genera in the Melastomataceae and several families in the Myrtales (Almeda, 1997a, 1997b), it is likely that some number in this range is the original base chromosome number in the

family. Thus, a polyploid origin for the Miconieae is clearly indicated, but unlike other tribes in the family, the Miconieae appear to have no extant taxa with lower base numbers that could qualify as ancestral base numbers (Almeda, 1997a).

Goldenberg and Shepherd (1998) demonstrated a close association between high chromosome number (above n = 17), low but highly variable pollen viability, and apomixis. Gametic chromosome counts of n = 23 and 24 have been reported for several species of *Clidemia* and *Miconia* (Almeda, 1997a; Almeda & Chuang, 1992; Solt & Wurdack, 1980), and those species with these higher numbers that have been investigated experimentally have been shown to be apomictic (Goldenberg & Shepherd, 1998). Apomixis has been reported or suspected in several species of Melastomataceae, a majority of which are concentrated in the tribe Miconieae (Almeda & Chuang, 1992; Goldenberg & Shepherd, 1998; Renner, 1989).

Access to good anthers with pollen was limited for most goblet-flowered species of *Clidemia* examined for this study. Pollen viability estimated for one individual of each species (based on a sample of 200 grains stained with aniline blue in lactophenol for 24 hrs.) was 51% for *C. utleyana* (*Almeda 6864*), 0% for *C. clandestina* (*Croat 67238*), and 5% for *C. garciabarrigae* (*Øllgaard 37666*). Judging from the extremely low pollen viability for the latter two species coupled with their higher chromosome number (n = 23), one may logically predict that they are also apomictic. Study of additional populations and emasculation experiments are needed, however, for all of the taxa treated here in order to confirm the occurrence of apomixis and to better evaluate any morphological, cytological, or environmental correlates with this breeding system.

Key to the Red Goblet-Flowered Species of *Clidemia*

1a. Leaf blades glabrous on the adaxial (upper) surface; inflorescence a multibranched paniculiform dichasium; bracts and bracteoles of the inflorescence widest at the base.

2a. Leaf blades essentially flat on the adaxial surface; abaxial (lower) surface with spreading smooth hairs restricted to the blade base where the primary veins diverge from the median vein; hypanthia minutely and deciduously brown-lepidote; petals copiously covered with minute papillae on both surfaces . . . . . *C. clandestina*

2b. Leaf blades bullate on the adaxial surface; abaxial leaf surface with smooth spreading hairs covering all the elevated veins and veinlets; hypanthia sparsely to moderately covered with smooth spreading hairs and a ground layer of scattered minute glandular-punctate hairs; petals completely smooth on both surfaces . . . . . *C. utleyana*

1b. Leaf blades pubescent on the adaxial surface; inflorescence a solitary or trifurcate collection of racemes; bracts and bracteoles of the inflorescence widest above the base . . . . *C. garciabarrigae*

1. Clidemia clandestina Almeda, sp. nov. TYPE: Panama. Coclé: Cerro Gaital, E slope and ridges leading to the summit with montane rainforest and elfin woodland, 8°40′N, 80°07′W, elev. 1050–1100 m, 24 Feb. 1988, *F. Almeda et al. 5907** (holotype, CAS; isotypes, AAU, CR, INB, MEXU, MO, NY, PMA). Figure 2.

Frutex terrestris vel epiphyticus. Ramuli primum quadrangulati demum teretes glabri. Lamina 5.7–14 × 3–7.3 cm elliptica vel elliptico-ovata apice acuminato vel caudato-acuminato basi obtusa vel rotundata, 3–5-plinervata, supra glabra, subtus in venarum primariarum axillis (et supra axillis) modice setosa pilis simplicibus 0.5–1 mm longis persistentibus. Inflorescentia 3–8.5 cm multiflora; flores 5-meri; calycis tubus 0.1–0.25 mm altus, lobis interioribus 0.25 × 0.5 mm triangularibus, dentibus exterioribus subulatis 0.25–0.5 mm eminentibus. Stamina isomorphica glabra; antherarum thecae 0.25 × 0.25 mm oblongae exappendiculatae, poro ventraliter inclinato. Ovarium 3-loculare et omnino inferum apice glabro.

Erect or scandent terrestrial shrub 1–2.5 m tall or dangling epiphyte. Internodes ± quadrate, becoming rounded with age, and sometimes bearing adventitious roots but otherwise essentially glabrous. Young vegetative buds, pedicels, and hypanthia minutely and caducously brown lepidote. Leaves of a pair ± equal in length or somewhat unequal but never markedly so; petioles 0.6–1.5 cm long; blades ± coriaceous when dry, 5.7–14 × 3–7.3 cm, elliptic sometimes varying to elliptic-ovate, apex acuminate to caudate-acuminate, base obtuse to rounded, margin entire to inconspicuously ciliate-serrulate, 3- to 5-plinerved with the innermost pair of primary veins diverging from the median vein 0.2–0.8 cm above the blade base, glabrous adaxially and moderately lepidote abaxially on the actual surface with hair-tuft domatia bearing hairs 0.5–1 mm long along the basal portion of the primary veins and where the innermost primaries diverge from the median veins at the blade base. Inflorescence a terminal modified dichasium 3–8.5 cm long becoming pseudolateral with elongation of lateral branches, sometimes divaricately branched from the base; bracts and bracteoles subulate to narrowly triangular, 0.5–1 mm long and about 0.25 mm wide at the base. Pedicels 0.5–1 mm long. Hypanthia (at anthesis) campanulate, ca. 1 mm long from the base to the vascular ring. Calyx tube 0.1–0.25 mm long, the calyx lobes 0.25 × 0.5 mm, bluntly triangular, hyaline and typically obscured

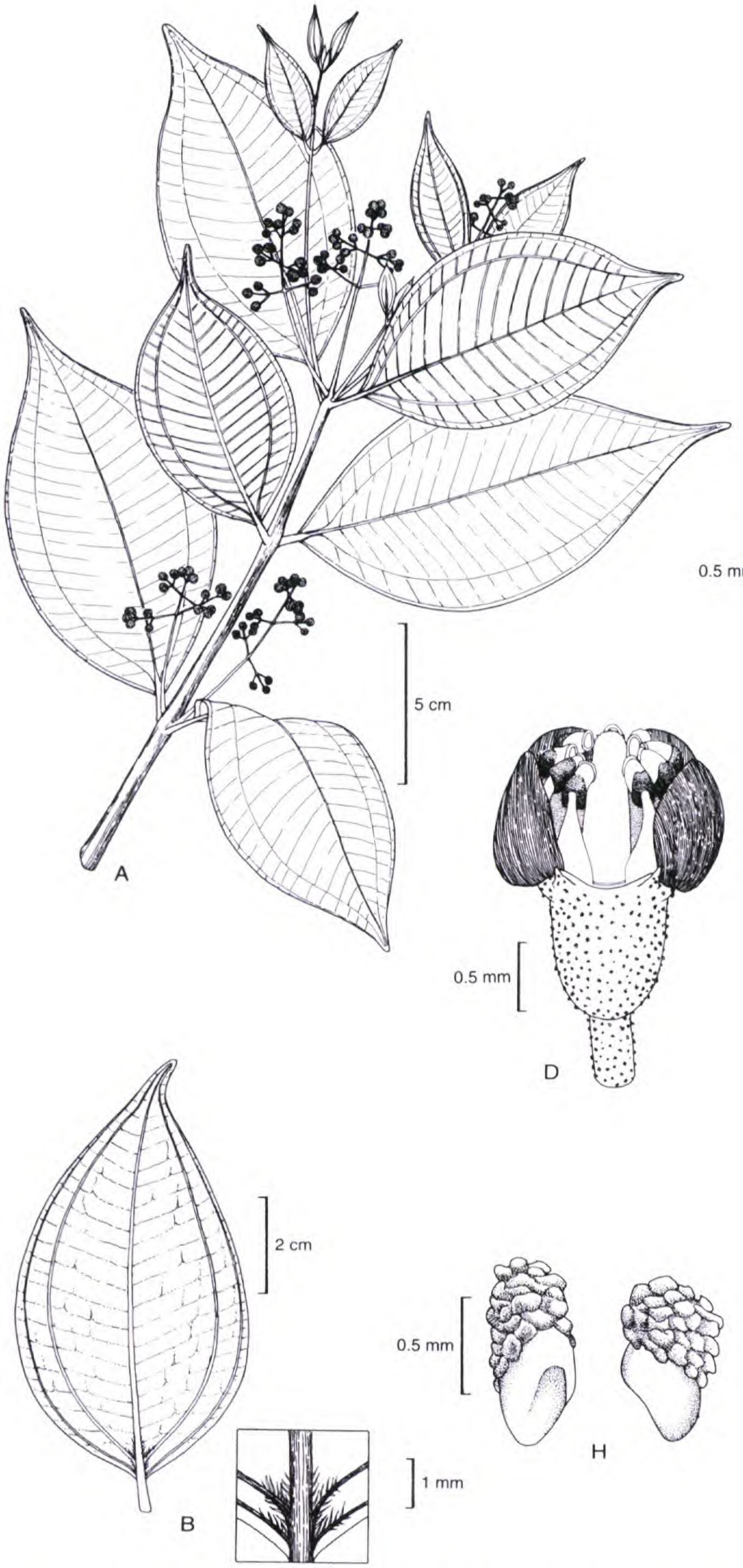

Figure 2. *Clidemia clandestina* Almeda. —A. Habit. —B. Representative leaf (abaxial surface) at left and leaf base (abaxial surface) at lower right. —C. Flower bud showing pedicel and subtending bracteoles. —D. Flower at anthesis (profile view) with one petal removed. —E. Petal (3/4 profile view) on left and enlargement of abaxial surface on right. —F. Stamens, ventral view on left and profile view on right. —G. Berries. —H. Seeds. (A–H from *Almeda et al. 5907.*)

by the exterior teeth; calyx teeth 5, linear to subulate, 0.25–0.5 mm long. Petals 5, copiously covered with minute papillae on both surfaces, dark red but drying maroon-black, obovate, erect and concave adaxially at anthesis, 1 mm long and 1 mm wide. Stamens 10, isomorphic and forming an incurved circle around the style; filaments glabrous, 1 mm long, gradually tapered from the base to the apex, pink but drying red; anthers 0.25 mm long and 0.25 mm wide, pale yellow flushed with crimson-maroon basally, ± oblong, rounded at the apex with a ventrally inclined pore; connective crimson-maroon but drying purple-black, thickened at the base of the anther sac but not conspicuously prolonged or appendaged. Ovary completely inferior, 3-locular, apex glabrous. Style straight, glabrous, 1.25 mm long; stigma blunt and rounded to ± truncate. Berry maroon when immature but turning purple-black when ripe, 4–5 × 4–5 mm when dry. Seeds ovoid to obovoid in outline, 1 mm long, bluntly and complexly tuberculate on the convex face.

Phenology. Collected in flower and fruit during February, March, July, August, November, and December.

Distribution. Local and uncommon in rain forests, cloud forests, and elfin woodland from northern and central Costa Rica disjunctly to western and central Panama at 700–1400 m.

Although collections of this species were first made in 1979, followed by several more in the 1980s, none had intact floral parts for critical analysis. Like so many Melastomataceae, the floral parts of this species are especially fugacious and unless care is taken to press flowers separately or preserve them in alcohol they are commonly absent on herbarium specimens. Details of floral morphology presented here were discernable only after I had the opportunity to study and collect this species in Panama in 1996.

Clidemia clandestina is readily distinguished from *C. garciabarrigae* and *C. utleyana* by its glabrous internodes and leaf blades that are glabrous adaxially and moderately lepidote abaxially on the actual surface with tufts of smooth spreading hairs along the basal portion of the primary veins and where the innermost primaries diverge from the median veins at the blade base. In addition, the young vegetative buds, pedicels, and hypanthia are minutely and caducously brown lepidote and the petals are distinctly papillose on both surfaces. The flowers of *C. clandestina* are small, dark red in color, and inconspicuous. The inflorescences are typically shorter than subtending leaves and often assume a position hidden under the blades. The specific epithet for this species, which is derived from the Latin word *clandestinus*, secret or hidden, emphasizes these features.

Paratypes. COSTA RICA. **Alajuela:** Cantón de San Ramón, Bosque Eterno de Los Niños, Cordillera de Tilarán, Valle del Río Peñas Blancas, 7 Oct. 1993, *Bello & Cruz 5364* (INB); Upala, Bijagua, El Pilón, Cabeceras del Río Celeste, 10°49′N, 84°27′W, 13 Nov. 1987, *Herrera 1263* (CAS, CR, MO); along road from San Ramón northward through Balsa, ca. 16.7 km N of bridge over Quebrada Volio and ca. 7.5 km N of bridge over Río Balsa, 10°10–15′N, 84°30–35′W, 29 Aug. 1979, *Stevens 13890* (CAS, CR, MO). **Limón:** Cantón de Talamanca, Bratsi, Amubri, Alto Lari, Kivat, bajando hacia el Río Dapari, margen derecha, 9°24′20″N, 83°05′35″W, 10 Mar. 1992, *Herrera 5280* (CAS, INB, MO); Cantón de Talamanca, Bratsi, Amubri, Alto Lari, Kivut, fila mayor entre los Ríos Dapari y Lari, desviándose hacia el este por fila secundaria, cuenca del Río Lari, 9°23′50″N, 83°05′10″W, 17 Mar. 1992, *Herrera 5383* (INB); Cantón de Talamanca, fila de exploracion minera entre Río Sukut y Río Carbri, Cerro Schtomat, 9°22′40″N, 82°56′30″W, 13 July 1989, *Solís et al. 21* (INB). PANAMA. **Chiriquí:** Fortuna Dam area about 3.7 km S of the Sitio de Presa offices, trail through Quebrada Aleman, 9 Feb. 1996, *Almeda et al. 7565* (CAS, MO, PMA); Fortuna Dam area, North Quebrada de Arena along river, 8°46'N, 82°12'W, 9 Feb. 1984, *Churchill et al. 4709* (MO). **Coclé:** vicinity of La Mesa, N of El Valle de Antón, along E edge of Cerro Gaital on hogback ridge leading to summit, 8°37'N, 80°08'W, 13 July 1987, *Croat 67238* (CAS); Cerro Gaital, elfin forest, 8°37'N, 80°6'W, 26 Nov. 1984, *de Nevers & Charnley 4379* (CAS); slopes and summit of Cerro Gaital, N of El Valle, 8°40'N, 80°07'W, 10 July 1982, *Knapp et al. 6008* (CAS); Divide SW of La Mesa at end of logging road, 80°5'W, 8°35'N, 26 Dec. 1982, *Stein & Hamilton 998* (CAS, MO).

2. Clidemia garciabarrigae Wurdack, Phytologia 7: 239. 1960. TYPE: Colombia. Nariño: between Altaquer and Ricuarte along the road to Barbacoas, 1140–1300 m, 3–5 Aug. 1948, *H. Garcia-Barriga 13116* (holotype, US; isotype, COL). Figure 3.

Terrestrial or epiphytic weakly branched shrub with pendent or arching branches 1–2 m long typically requiring the support of adjacent vegetation. Internodes ± terete and covered with smooth, eglandular, spreading hairs (0.5–)1–3 mm long like the inflorescence rachis and both foliar surfaces; the nodes ± swollen. Leaves of a pair dimorphic in size and shape; blades subcoriaceous when dry, the larger one at each node, 6–10.2 × 2–5.4 cm, ovate-elliptic to ovate-oblong, apex abruptly acuminate, base broadly rounded to subcordate, margin entire, 5-nerved or 5-plinerved, the innermost pair of primaries diverging from the median vein 2–3 mm above the blade base; petiole 3–5 mm long; the smaller blade 1.7–4.4 × 1.5–3.6 cm, broadly ovate, apex short-apiculate, base cordate,

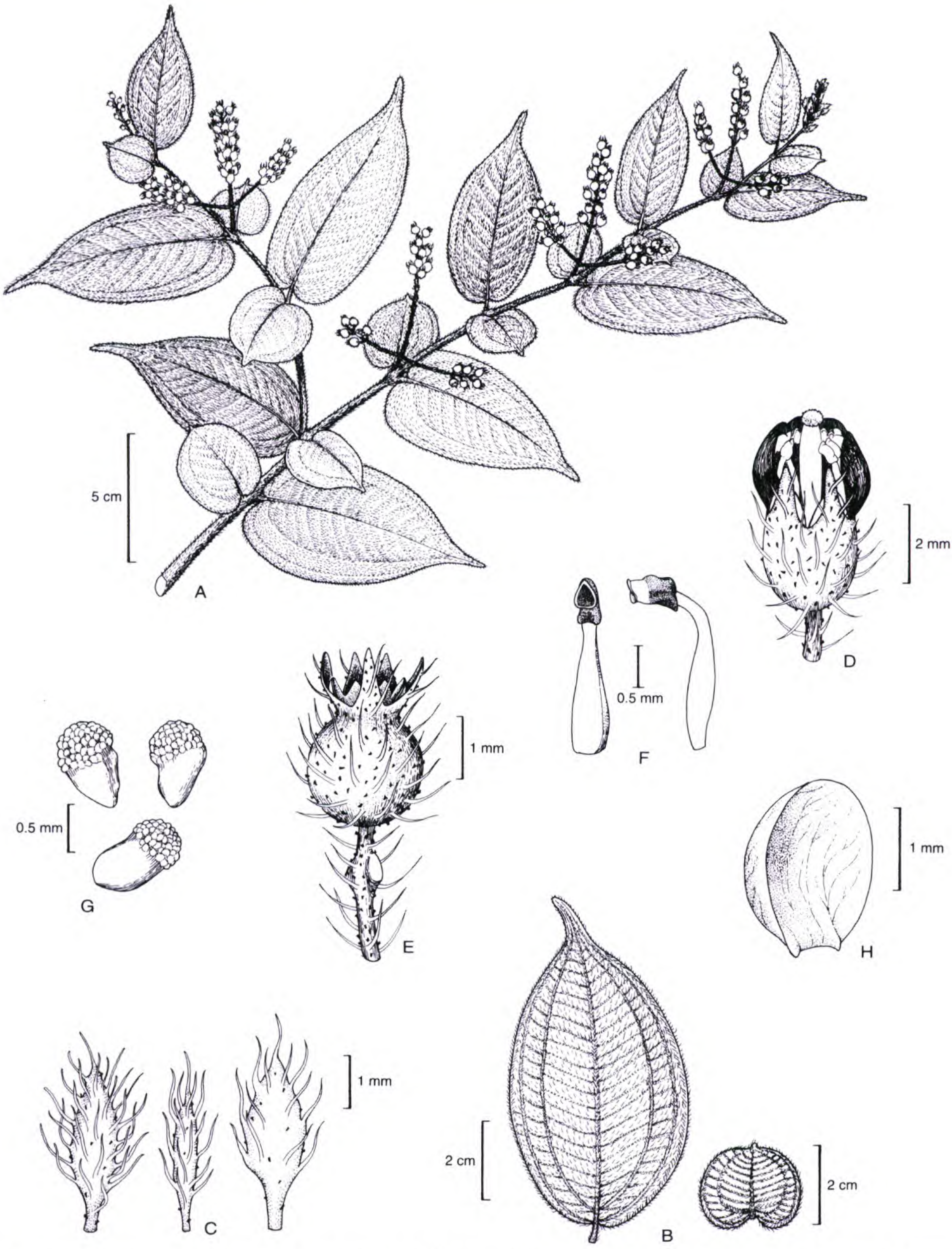

Figure 3. *Clidemia garciabarrigae* Wurdack. —A. Habit. —B. Representative leaves at a node, larger leaf showing abaxial surface (left) and smaller leaf showing abaxial surface (right). —C. Floral bracteoles (abaxial surfaces). —D. Flower at anthesis (profile view) with one petal removed. —E. Immature berry (profile view). —F. Stamens, ventral view on left and profile view on right. —G. Seeds. —H. Petal (3/4 profile view). (A, G from *Hampshire & Whitefoord 738*; B–F, H from *Almeda et al. 7504*.)

margin entire, 3–5-nerved, petiole barely prolonged and subsessile or up to 1 mm long. Inflorescence a trifurcate raceme or occasionally a solitary raceme 3.5–5 cm long that is at first terminal but becomes pseudolateral with elongation of lateral branches; bracteoles elliptic to linear-oblong or somewhat obovate, tardily deciduous, 2–4 × 0.25–2.5 mm, glabrous adaxially, sparsely to moderately covered abaxially with smooth spreading hairs and a sparse ground layer of small glands. Pedicels (at anthesis) 0.25–1 mm long. Hypanthia (at anthesis) campanulate to cupulate, 1–1.5 mm long from the base to the vascular ring, sparsely covered with smooth spreading hairs 0.5–1.5 mm long and a ground layer of scattered rusty-brown glandular hairs. Calyx tube obsolete, the calyx lobes 0.5–0.8 × 0.75 mm, rounded-triangular, somewhat hyaline and mostly obscured by the exterior teeth; calyx teeth 5, narrowly triangular, 1 × 0.75 mm. Petals 5, glabrous, dark red but drying maroon-black, suborbicular, erect, connivent and concave adaxially at anthesis, 1.5–2 × 1.5–2 mm. Stamens 10, isomorphic and forming an incurved circle around the style; filaments glabrous, 1–1.5 × 0.25 mm, gradually tapered from the base to the apex; anthers 0.5 × 0.5 mm, pale yellow apically but deep red toward the base, ± oblong to somewhat rectangular in outline, ± rounded apically with a ventrally inclined pore; connective crimson-maroon but drying purple-black, thickened and ± truncate ventrally at the base of the anther sac but not prolonged or appendaged. Ovary completely inferior, 3-locular, apex glabrous and 10-costate. Style straight, glabrous, 2–2.5 mm long; stigma truncate to ± rounded. Berry changing through green, red, blue, and ultimately black when ripe, 4–5 × 4–5 mm when dry. Seeds ± obovoid in outline, 1 mm long, tuberculate on the broader distal end.

Phenology. Collected in flower and fruit from February through April and in September and November.

Distribution. Local and uncommon in open areas in cloud forests and lake margins from disjunct localities in western and central Panama to southern Colombia and northern Ecuador at 700–1300 m. The label on a collection from Carchi, Ecuador (*Tipaz et al. 1035*), gives the elevation as 3200 m. This is extraordinarily high for this species and should be regarded with suspicion until confirmed.

In the protologue, this species was reported only from Colombia. It was first collected in Ecuador in 1979. Although it wasn't included in Wurdack's (1980) melastome treatment for Ecuador, it was reported from that country shortly thereafter (Wurdack, 1982: 61). The range of *C. garciabarrigae* is here extended north to Panama, making it the most widespread member of the globlet-flowered species of *Clidemia*.

Clidemia garciabarrigae differs from the other two species treated here in having an indument of smooth, spreading hairs on both foliar surfaces, leaf blades that are conspicuously dimorphic in size and shape at each node, and an inflorescence that typically consists of trifurcate (sometimes varying to solitary) racemes. It also differs from both congeners by its floral bracteoles that are widest well above the base.

Representative specimens examined. ECUADOR. **Carchi:** El Pailon, ca. 45 km below Maldonado along a footpath to Tobar Donoso, 2 Nov. 1979, *Madison & Besse 7093* (US); Cantón Parroquia Chical, sector Gualpi medio, Reserva Indígena Awá, sendero a San Marcos al norte de la casa comunal, 78°16′W, 01°02′N, 23–27 May 1992, *Tipaz et al. 1035* (CAS, MO). **Esmeraldas:** San Lorenzo Cantón Reserva Indígena Awá, cañon del Río Mira, 10 km al oeste de Alto Tambo, 78°26′W, 01°02′N, 16–26 Mar. 1991, *Rubio et al. 1227* (US). **Pichincha:** Road El Paraíso–Saguangal, 11 km from El Paraíso, 78°46′W, 0°12′N, 2 May 1982, *Øllgaard et al. 37666* (CAS). PANAMA. **Chiriquí:** Edwin Fabrega Dam and Reserve in Fortuna, Quebrada Bonita ca. 7.5 km N of Sitio de Presa office enroute to Chiriquí Grande, 5 Feb. 1996, *Almeda et al. 7504** (BM, CAS, INB, MO, MEXU, PMA); Gualaca-Chiriquí Grande, 4–8 mi. beyond IRHE facilities at Dam, 4 mi. N of bridge over Bayano Lake, 8°46′N, 82°16′W, 23 Sep. 1987, *Croat 68019* (CAS, MO, PMA); Fortuna Lake, cleared forest on banks of lake, 8°45′N, 82°12′W, 20 Mar. 1985, *Hampshire & Whitefoord 738* (CAS, MO); Fortuna, camino de Quebrada Bonita llegando por el embalse hacia el norte, 8 Apr. 1987, *Valdespino et al. 596* (CAS, PMA). **Coclé:** forested slopes above El Copé along abandoned road leading to the Continental Divide, 25 Feb. 1988, *Almeda et al. 5944* (CAS).

3. Clidemia utleyana Almeda, Bull. Torrey Bot. Club 106: 189. 1979. TYPE: Costa Rica. Cartago: continuation of C.R. #224 on the property of ICE hydroelectric plant (now Tapantí National Park), about 4.4 km beyond main gate to property and 17 km beyond the Church in Orosí, elev. 1500–1800 m, 13 Dec. 1975, *F. Almeda & J. Utley 2666* (holotype, CAS; isotypes, CR, F, MO, US).

Laxly branched erect to reclining terrestrial or epiphytic shrub mostly 0.5–1.5 m tall. Internodes and uppermost branchlets terete, moderately to copiously beset with smooth, eglandular, spreading hairs mostly 1–2 mm long like the inflorescence rachis. Leaves of a pair somewhat unequal in size, otherwise identical in shape and indument details, blades chartaceous to subcoriaceous when dry, entire but conspicuously revolute, narrowly ovate to

± cordate, 5- to 7-nerved, glabrous and bullate adaxially, the abaxial surface beset with a mixture of smooth spreading hairs and sessile glandular hairs largely confined to the elevated primary and secondary veins; petioles 1.5–3 mm long or the blades occasionally subsessile and ± clasping. Larger leaf at each node 4–10 × 1.5–4.5 cm. Smaller leaf (2–)3–6 × 1–4 cm. Inflorescence a terminal modified dichasium 1.5–2.5 cm long becoming pseudolateral with elongation of lateral branches; bracteoles linear-lanceolate to subulate, persistent, 2–4 × 0.5 mm, beset with spreading simple hairs and sessile glandular-punctate hairs abaxially or essentially glabrous and then tipped with an apical hair. Pedicels (at anthesis) 0.5–1 mm long. Hypanthia (at anthesis) campanulate, 1–1.5 mm long from the base to the vascular ring, sparsely covered with smooth spreading hairs and a ground layer of scattered glandular-punctate hairs. Calyx tube 0.25 mm long, the calyx lobes 1 × 1 mm, rounded-triangular, somewhat hyaline and obscured by the exterior teeth; calyx teeth 5, lance-triangular to ± setiform, 0.25–0.5 × 0.25 mm. Petals 5, glabrous, dark red, ovate to narrowly obovate, minutely glandular-ciliolate, erect, connivent and concave adaxially at anthesis, 1.5–2 × 1–1.5 mm. Stamens 10, isomorphic and forming an incurved circle around the style; filaments glabrous, 1–1.5 × 0.5 mm, subulate; anthers 0.5 × 0.25 mm, pale yellow flushed with red along the connective dorsally and basally at the filament insertion, oblong to obovoid in outline, ± truncate distally with a ventrally inclined pore; connective thickened dorso-basally but not dilated or prolonged below the thecae. Ovary completely inferior, 3-locular, apex glabrous and 10-costate. Style straight, glabrous, 2 mm long; stigma truncate. Berry dark purple at maturity, 4–4.5 × 4–5 mm. Seeds narrowly pyriform, 1 mm long, ± papillate on the broader distal end.

Phenology. Collected in flower and fruit from November through February and from June through August.

Distribution. Rare and local in cloud forests and ridgetop elfin vegetation in seepage areas, partially shaded vertical banks, and secondary thickets from central Costa Rica disjunctly south to western Panama with one known population in western Colombia from 1090 to 1800 m.

Among the three goblet-flowered species, *C. utleyana* is most similar to *C. garciabarrigae* but differs most notably in its leaf blades that are glabrous and bullate adaxially. It also differs in its dichasial inflorescence and its floral bracteoles that are broadest at the base.

For an illustration of this species see Almeda (1979: 190).

Representative specimens examined. COLOMBIA. **Chocó:** Carretera Ansermanuevo/San José del Palmar, 8.4 km del Alto del Galápago, 19 Feb. 1977, *Forero et al. 3015* (COL). COSTA RICA. **Cartago:** Refugio Nacional de Vida Silvestre Tapantí, Sendero Oropendola and vicinity, approximately 1.2–2.7 km from the reserve entrance, 1 Mar. 1991, *Almeda et al. 6864** (AAU, BM, CAS, CR, INB, MEXU, MO, NY, PMA); Tapantí Hydroelectric Reserve along Río Grande de Orosí, 4.5 km beyond small bridge which crosses river inside the preserve, along road to diversion dam, 23 June 1976, *Croat 36084* (CAS). **Heredia:** Parque Nacional Braulio Carrillo between Río Peje and Río Sardinal, Atlantic slope of Volcán Barva, 10°15.5′N, 84°05′W, 13 Nov. 1986, *Grayum & Herrera 7877* (CAS, INB, MO). PANAMA. **Bocas del Toro:** Edwin Fabrega Dam and Reserve in Fortuna along the Continental Divide Trail, 12.9 km N of Sitio de Presa offices above the Dam, 08°45′04″N, 82°15′04″W, 7 Feb. 1996, *Almeda et al. 7534* (CAS, MO, PMA). **Chiriquí:** Edwin Fabrega Dam and Reserve in Fortuna, Quebrada Bonita ca. 7.5 km N of Sitio de Presa offices enroute to Chiriquí Grande, 5 Feb. 1996, *Almeda et al. 7503* (CAS, PMA). **Veraguas:** summit of Cerro Tute with low windswept fog-shrouded elfin vegetation, 18 Feb. 1996, *Almeda et al. 7629* (CAS, PMA).

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Arabidopsis bactriana Belongs to *Dielsiocharis* (Brassicaceae)

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ABSTRACT. The Tajikistan endemic *Arabidopsis bactriana* is transferred to *Dielsiocharis*, a genus previously recognized as monotypic. Detailed description of *A. bactriana* is provided, and a key distinguishing the two species of *Dielsiocharis* is given.

Key words: *Arabidopsis*, Brassicaceae, *Dielsiocharis*, Tajikistan.

During a visit to Dushanbe (Tajikistan) in 2002, the first author had the chance to examine many species of Brassicaceae at TAD. One of the species, previously placed in *Arabidopsis* (DC.) Heynhold, *A. bactriana* Ovczinnikov & Junussov, was studied critically, and the present paper deals with its proper generic placement.

Arabidopsis bactriana cannot be maintained in *Arabidopsis* because it is a pulvinate, scapose, canescent perennial with almost exclusively dendritic trichomes, leafless stems, pale yellow flowers, and non-torulose fruits. As defined by O'Kane and Al-Shehbaz (1997), *Arabidopsis* consists of annual, biennial, or non-pulvinate, non-scapose, non-canescent perennials with simple and forked (never dendritic) trichomes, leafy stems, white to lavender or rarely purple flowers, and torulose fruits.

Al-Shehbaz et al. (1999) excluded *Arabidopsis bactriana* from *Arabidopsis* and, prior to the examination of the type material, suggested that the species might belong to *Crucihimalaya* Al-Shehbaz et al. However, we now believe that the species should be assigned to *Dielsiocharis* O. E. Schulz, a genus previously recognized by Schulz (1924, 1936) and Hedge (1968) as monotypic.

In nearly all aspects of *Arabidopsis bactriana*, the species is more closely related to *Dielsiocharis kotschyi* (Boissier) O. E. Schulz (northern Iran and adjacent southern Turkmenistan) than to any other species of the Brassicaceae. Both are densely caespitose, pulvinate, tomentose, canescent, scapose perennials with almost exclusively dendritic trichomes (some simple trichomes at the petiolar base); entire, oblong, oblanceolate, or obovate, rosulate basal leaves attenuating to the petiole; leafless stems; ebracteate, few- to several-flowered racemes elongated in fruit; bright or pale yellow petals 2.5–5 mm long; linear to oblong-linear, often recurved, non-torulose, dehiscent, terete fruits; minute, entire stigmas; and oblong, uniseriate seeds with incumbent cotyledons (Hedge, 1968; Junussov, 1978).

Dielsiocharis bactriana (Ovczinnikov & Junussov) Al-Shehbaz & Junussov, comb. nov. Basionym: *Arabidopsis bactriana* Ovczinnikov & Junussov, Fl. Tajikistan 5: 626. 1975. TYPE: Tajikistan. Mt. Kugi-Frusch, calcareous ground, 2800 m, 4 July 1956, *P. N. Ovczinnikov & M. S. Lazareva 4079* (holotype, TAD; isotype, TAD).

Perennial herbs to 4 cm tall, pulvinate, scapose; caudex woody, compact, covered with persistent leaves of previous years. Leaves oblong-oblanceolate to obovate, 0.3–2 cm long, 1–3.5 mm wide, canescent, densely tomentose with stalked, dendritic trichomes, these with much longer stalks and simple along petiolar base, base attenuate or cuneate, margin entire, apex obtuse. Cauline leaves absent. Raceme ebracteate, 3- to 6-flowered, elongated in fruit. Sepals oblong, to 2 mm long, tomentose outside. Petals pale yellow, narrowly oblanceolate, 2.5–3 mm long, apex rounded. Fruiting pedicel slender, filiform, 5–10 mm long, sparsely tomentose. Ovules 34 to 40 per ovary. Fruit linear, terete, curved, not torulose, 7–15 × 0.7–1 mm; valves glabrous, midvein absent or obscure; style 0.1–0.5 mm long; stigma minute, entire. Seeds uniseriate, oblong, brown, ca. 0.7 × 0.3 mm long; cotyledons incumbent.

Dielsiocharis bactriana is known thus far only from the type collection. It is easily distinguished from *D. kotschyi* by having fewer-flowered racemes,

glabrous fruit valves, and more ovules per ovary (see key).

KEY TO THE SPECIES OF *DIELSIOCHARIS*

1a. Fruit valves glabrous; racemes 3- to 6-flowered; ovules 34 to 40 per ovary . . . . . *D. bactriana*
1b. Fruit valves pubescent; racemes 10- to 20-flowered; ovules 6 to 14 per ovary . . . . . *D. kotschyi*

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Drabopsis Is United with *Draba* (Brassicaceae)

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ABSTRACT. *Drabopsis nuda* is transferred to *Draba*, and the two genera are united. The distinguishing characters separating these two genera and *Arabidopsis* are discussed.

Key words: *Arabidopsis*, Brassicaceae, Cruciferae, *Draba*, *Drabopsis*.

The systematic position of *Drabopsis* K. Koch has been the source of continuous controversy. The genus has long been considered to be monotypic. Naqshi and Javied (1984) added another species, *D. brevisiliqua* Naqshi & Javied, that was said to differ from the highly variable *D. nuda* (Bélanger) Stapf by having shorter fruits (ca. 1.2 cm) and nonflexuous scapes. In our opinion, these differences are trivial and *D. brevisiliqua* is reduced to synonymy of *D. nuda* (see below).

Drabopsis nuda is distributed from western Xinjiang (China), central Asia, Kashmir, and Afghanistan westward into Iran, Iraq, Turkey, Caucasus, and Crete (Gustavsson, 1977). The nomenclature of the species has been dealt with by Léonard (1977), and the species should be recognized as *D. nuda*, instead of the later-published *D. verna* K. Koch, as was done by Cullen (1965), Hedge (1968), Jafri (1973), and Gustavsson (1977).

Drabopsis nuda does not fit appropriately in any genus. It was originally described as *Arabis* L., and it resembles *Arabis auriculata* Lamarck in having linear, somewhat latiseptate fruits, stout fruiting pedicels nearly as thick as fruit, and accumbent cotyledons. However, the species cannot be accommodated in *Arabis* because it has yellow flowers and leafless scapes. The presence in *D. nuda* of accumbent instead of incumbent cotyledons and leafless instead of leafy stems strongly supports its exclusion from *Sisymbrium* L., where it was placed by Boissier (1867).

Busch (1909) and Bornmüller (1911) transferred *Drabopsis verna* and *D. nuda* to *Arabidopsis* (DC.) Heynhold, respectively. No reasons were given to support such transfer, and Jafri (1973) recommended that the two genera be united, though he maintained both. The lack in *Drabopsis nuda* of any cauline leaves and the presence of stout fruiting pedicels nearly as thick as the fruit, yellow flowers, and stalked, almost exclusively stellate trichomes clearly do not support its placement in *Arabidopsis*. All species of *Arabidopsis* have cauline leaves, fruiting pedicels narrower than fruits, white to lavender flowers, and a mixture of simple and forked trichomes. Furthermore, molecular data (O'Kane & Al-Shehbaz, in prep.) demonstrate that *Arabidopsis* and *Drabopsis* are unrelated. Al-Shehbaz et al. (1999) excluded the species from *Arabidopsis* but maintained it in *Drabopsis*.

The recognition of *Drabopsis* as a monotypic genus does not solve its affinity and relationship. In every aspect of its scapose habit, leafless scapes, annual duration, flower color, accumbent cotyledons, and trichome morphology, *Drabopsis nuda* is more at home in *Draba*. In fact, Boissier (1867) was the first to point out the resemblance of the species to *Draba* L. (as *Erophila* DC.). The only morphological oddity brought about by the placement of *Drabopsis nuda* in *Draba* is the relative length/width ratio of the fruit. No other species in *Draba* has fruits as many as 45 times longer than broad, though this extreme length/width ratio of the fruits in *Drabopsis nuda* is the maximum, and according to Zhou et al. (2001), the species has fruits (10–) 17–33(–45) × 0.8–1 mm. Other species of *Draba* with linear fruits as long as 30 times the width are found in the Himalayan and central Asian *D. aucheri* Boissier and the Tibetan *D. nylamensis* Al-Shehbaz (Al-Shehbaz, 2002).

Schulz (1936) placed *Drabopsis* in the tribe Arabideae and *Draba* in the tribe Drabeae. His tribal assignment of the two genera is not supported by morphological or molecular data, and it has been shown that the closest relatives of *Draba* s.l. are

Eurasian *Arabis* and *Aubrieta* Adanson (Koch & Al-Shehbaz, 2002).

Molecular studies (Koch & Al-Shehbaz, unpublished) clearly show that *Drabopsis nuda* is close to the annual species of *Draba* (e.g., *D. nemorosa* L., *D. muralis* L., *D. verna* L.). Phylogenetic analysis using DNA sequence variation of the internal transcribed spacers ITS-1 and ITS-2 of nuclear ribosomal DNA demonstrated that *Draba* (including *Erophila*) forms a monophyletic assemblage. The vast majority of perennial species of *Draba* are combined to one large group, and all annual taxa, including *Drabopsis nuda*, are positioned basal to them.

Draba nuda (Bélanger) Al-Shehbaz & M. Koch, comb. nov. Basionym: *Arabis nuda* Bélanger, Voy. Indes Or., Bot. t. 15a. 1834. TYPE: illustration t. 15a.

Drabopsis brevisiliqua Naqshi & Javied, J. Econ. Tax. Bot. 5: 966. 1984. Syn. nov. TYPE: Kashmir. Harwan, *A. R. Naqshi 3784* (KASH).

Draba nuda is easily distinguished from all of the other annual, yellow-flowered species of *Draba* by having leafless scapes, stout fruiting pedicels nearly as thick as the fruit, slightly flexuous rachis, and slightly compressed, slender, linear fruits (1–) 1.7–3.3(–4.5) cm × 0.8–1.2(–1.6) mm.

Acknowledgments. We are grateful to Victoria C. Hollowell and Steve L. O'Kane, Jr., for their comments on the manuscript.

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Three New Species of *Biophytum* (Oxalidaceae) from the Venezuelan Guayana

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ABSTRACT. *Biophytum kayae*, *B. lourteigiae*, and *B. ottohuberi* from Bolívar and Amazonas states in Venezuela are newly described and illustrated. All are members of section *Dendroidea* Knuth and have sessile or shortly pedunculate inflorescences. *Biophytum ottohuberi* is a distinctive, high-elevation tepui endemic with small leaves and rigidly coriaceous, thick-margined leaflets; *B. lourteigiae* and *B. kayae* are both lowland species on predominantly white-sand substrates. *Biophytum lourteigiae* is a taller shrub than *B. kayae* and has longer, less coriaceous leaves and more pubescent capsules. Too few flowering specimens were available to assess whether any of these species are heterostylous, but the flowers that were examined have their stigmas and two sets of stamens positioned in a way that is consistent with tristyly.

Key words: *Biophytum*, heterostyly, Oxalidaceae, tristyly, Venezuela.

Biophytum DC. is a pantropical genus of about 80 species (Lourteig, 1980) that is distinguished from other genera of Oxalidaceae by its clusters of paripinnately compound leaves at the branch tips. While preparing the Oxalidaceae treatment for the *Flora of the Venezuelan Guayana* (Aymard & Berry, 2003), we found several specimens of *Biophytum* that could not be placed with any known species in the genus. Further examination showed these to be new taxa, and they are described below as new species. All three species of *Biophytum* belong to the large Neotropical section *Dendroidea* (Knuth, 1930), by virtue of their small, elongate- or rectangular-falcate leaflets, often reduced peduncles or pedicels, headlike inflorescences, and numerous bracteoles.

Biophytum is one of only eight genera in three families of flowering plants (Lythraceae, Oxalidaceae, and Pontederiaceae) where trimorphic heterostyly, or tristyly, has been clearly demonstrated (Weller, 1992). In tristylous species, there are three floral forms that differ in the positions of the stigmas and the two sets of anthers; in the short-styled morph, the stigmas occur in the low position and the anthers in the middle and high positions. The mid-style morph has the anthers in the low and high positions, and the long-styled morph has its anthers in the low and middle positions. The presence of tristyly in *Biophytum* is based entirely on observations of a single species, *B. sensitivum* (L.) DC. (Darwin, 1877; Mayura Devi, 1964). Later, Mayura Devi (1966) found a homostyled population of the same species; these plants all had flowers with the same "mid-homostyle" morphology, that is, the styles corresponded to the mid-style position of the tristyled forms, and the stamens corresponded to the middle and high positions. It is not uncommon for tristylous breeding systems to "break down," that is, show changes that result in distyly, homostyly, or the loss of self-incompatibility (Weller, 1992).

In the species described below, the flowers are clustered near the base of the leaf rosette. When dried as herbarium specimens, the leaves often completely cover the inflorescences, and it is usually not possible to examine the flowers or fruits without causing considerable damage to the specimen. Since there were so few specimens of these species available for study, we limited our floral dissections to a single collection of each species. Consequently, we cannot determine with certainty if these species are tristylous, but we can infer from the relative position of anthers and styles in each species which morph they would represent if the species are indeed tristylous.

Biophytum kayae Aymard & P. E. Berry, sp. nov. TYPE: Venezuela. Amazonas: Río Negro, between Neblina base camp and the mouth of Canyon Grande at Puerto Chimo, along Río Mawarinuma, 00°50′N, 66°10′W, 130–200 m, 6–7 July 1984, *G. Davidse & J. Miller 27052* (holotype, VEN; isotypes, MO, P not seen, PORT). Figure 1A–C.

Biophyto lourteigiae affinis, sed inflorescentiis subsessilis, foliis minoribus rhachidibus 4–6 cm longis, foliolis coriaceis supra reticulate nervatis et capsulis glabris, recedit.

Shortly branched subshrub, the stems 30–50 cm tall, 5–8 mm in circumference at thickest point, erect; branches and branchlets glabrous. Leaves 8 to 13 per cluster, 12- to 14-jugate, rachis 4–6 cm long, densely appressed-barbate on young leaves, glabrescent; leaflets sessile, 1–5 × 1–4 mm, obliquely rhomboid, coriaceous, glabrous and with venation evident on the upper surface, the lower surface reticulately veined and papillate, 12- to 16-veined, the base truncate, the apex obliquely and broadly acute, the margins ciliate when young, glabrescent. Peduncle ca. 2 mm long, glabrous; bracteoles ca. 15, lanceolate, 1–2 mm long, glabrous, ciliate at the margins. Flowers examined (from the type collection) consistent with the short-styled floral morph (if tristylous), pedicels ca. 1 mm long; sepals lanceolate, 3–4 mm long, 12- to 14-nerved, glabrous, margins smooth; petals oblong, white, glabrous, ca. 5 mm long; longer stamens ca. 4 mm long, filaments pilose, shorter stamens ca. 2 mm long, filaments glabrous, the anthers ovoid, 0.2–0.3 mm long; ovary 5-lobed, ca. 1 mm long, sparsely appressed-pilose; styles 5, 0.3–0.6 mm long, stigmas capitate. Capsules 5-lobed, ca. 5 mm long, glabrous; carpels 1-seeded; seed ellipsoidal, ca. 2 mm long, glabrous, slightly striate.

Habitat and distribution. *Biophytum kayae* is known from moist forest understories in areas predominated by white-sand substrates in two areas: near the base of Serranía La Neblina close to the Brazilian border, and farther north in the Río Cuao basin, both in Amazonas state, Venezuela. In both areas, the species occurs at elevations between 130 and 200 m.

Biophytum kayae is similar to *B. lourteigiae* in its obliquely rhomboid leaflets, short inflorescence, and overall leaf dimensions. However, it is a consistently smaller shrublet, with smaller leaves that are fewer in number per cluster (8 to 13 vs. 10 to 18 in *B. lourteigiae*), with more coriaceous and reticulate leaflets, sepals with more veins (12–14 vs. 6–8), shorter peduncles (2 mm vs. 2–7 mm), and glabrous capsules.

Paratypes. VENEZUELA. **Amazonas:** Río Cuao, *H. M. Curran 233* (NY); base of Cerro La Neblina, Río Mawarinuma, vicinity of Puerto Chimo, 00°50′N, 66°05′W, 190 m, *A. Gentry & B. Stein 46929A* (MO, PORT, VEN); base camp on Río Mawarinuma, 00°50′N, 66°10′W, 140 m, *R. Liesner & V. Funk 15864* (MO, PORT, VEN), same locality as previous one, *R. Kral 71999* (VEN).

This species is named for Kay Yatskievych, the resourceful and hard-working editor of the *Flora of the Venezuelan Guayana* series over many years. In that flora's treatment of Oxalidaceae (Aymard & Berry, 2003), this species was treated as "*Biophytum* sp. *C.*"

Biophytum lourteigiae Aymard & P. E. Berry, sp. nov. TYPE: Venezuela. Amazonas: alto Río Orinoco, Caño Soromoni, 15 km W of La Esmeralda, 03°08′N, 65°38′W, 140 m, 28 Feb. 1990, *G. Aymard & L. Delgado 8345* (holotype, PORT; isotypes, MO, NY). Figure 2A–D.

Biophyto ferrugineo proxima, sed foliolis 3–6 mm longis, 2–4 mm latis, bracteolis glabris, subulato-lanceolatis, sepalis 3–3.5 mm longis, glabris; petalis 4–5 mm longis et staminibus majoribus ca. 4 mm longis, minoribus ca. 1 mm longis recedit.

Densely branched subshrub 0.5–1.5 m tall, thickest branches 10–12 mm in circumference, erect; branches and branchlets densely appressed-pubescent at the apex, sparsely appressed-pubescent to glabrescent when mature. Leaves 10 to 18 per cluster, 7-to 18-jugate, rachis densely barbate, 4–10 cm long, retrorse bristles present on young stems just below leaf cluster, soon deciduous; leaflets sessile, 3–6 × 2–4 mm, broadly and obliquely rhomboid or subrectangular, chartaceous to subcoriaceous, glabrous on upper surface with venation obscure, papillate and with evident venation on lower surface, veins parallel and 8 to 12 on each side of the midvein, the base truncate, the apex broadly and obliquely acute, margins densely ciliate-barbate when young, glabrescent. Inflorescence subterminal, peduncle 2–7 mm long, sparsely pubescent; bracteoles 8 to 15, subulate-lanceolate, 1–1.5 mm long, lightly pubescent on both sides and ciliate at the margins; pedicels glabrous, ca. 2 mm long. Flowers examined (from the type collection) consistent with the mid-styled floral morph (if tristylous); sepals lanceolate, 3–3.5 mm long, 6- to 8-nerved, sparsely pubescent externally; petals white, obovate, 4–5 mm long, glabrous on both sides, 4- or 5-nerved; longer stamens ca. 4 mm long, filaments pilose, shorter stamens ca. 1 mm long, filaments glabrous, the anthers ovoid, ca. 0.4 mm long; ovary ca. 1 mm long, densely

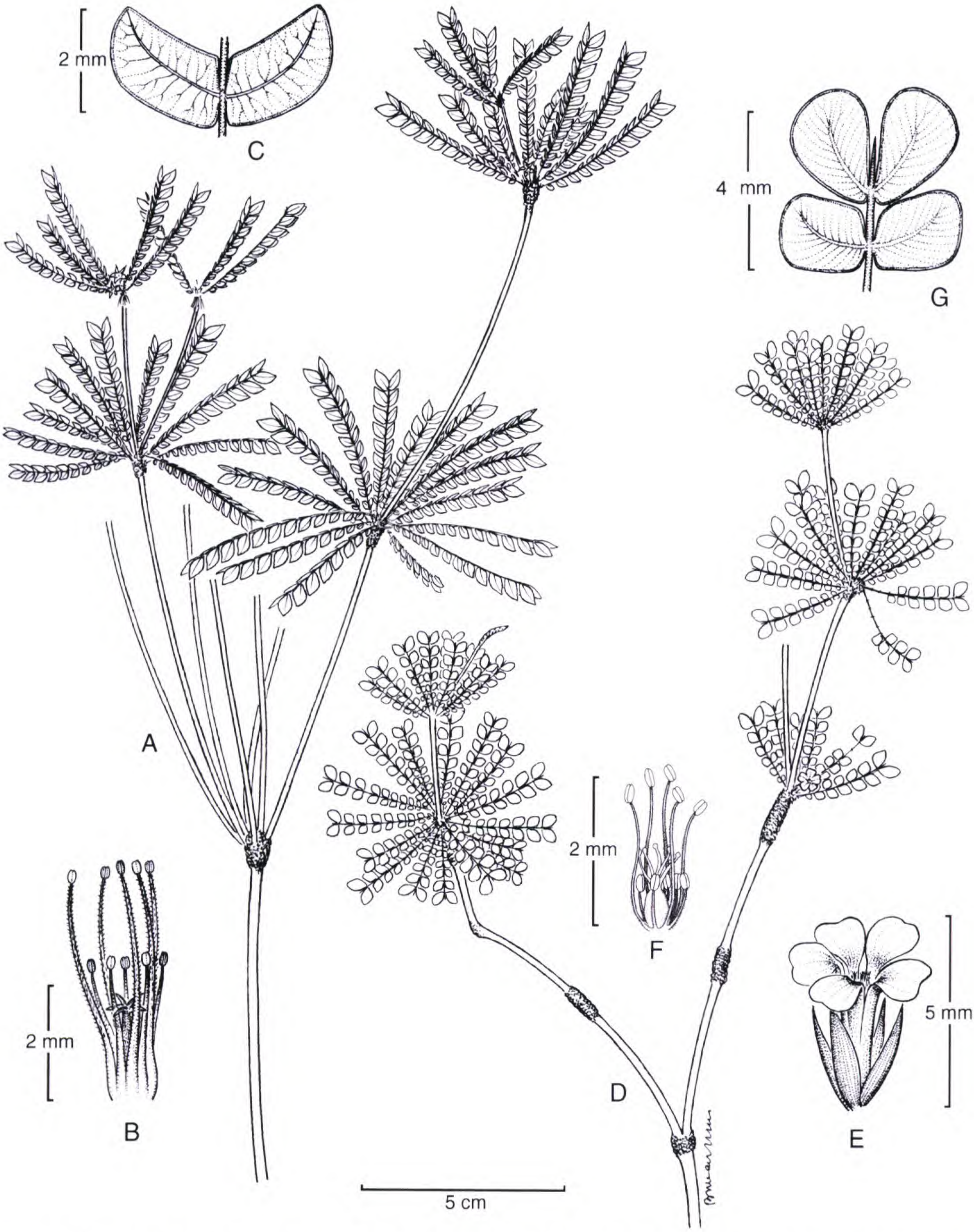

Figure 1. A–C. *Biophytum kayae* Aymard & P. E. Berry. —A. Habit. —B. Flower (short-style form) with sepals and petals removed, showing the short style and two longer whorls of stamens. —C. Pair of leaflets showing the lower surface. Drawn from the holotype, *G. Davidse & J. Miller 27052* (VEN). D–G. *Biophytum ottohuberi* Aymard & P. E. Berry. —D. Habit. —E. Whole flower. —F. Flower (mid-style form) with sepals and petals removed, showing the middle position of the styles between the two whorls of stamens. —G. Distal pairs of leaflets showing the upper surface and the thickened margins. Drawn from the holotype, *O. Huber 10963* (MYF).

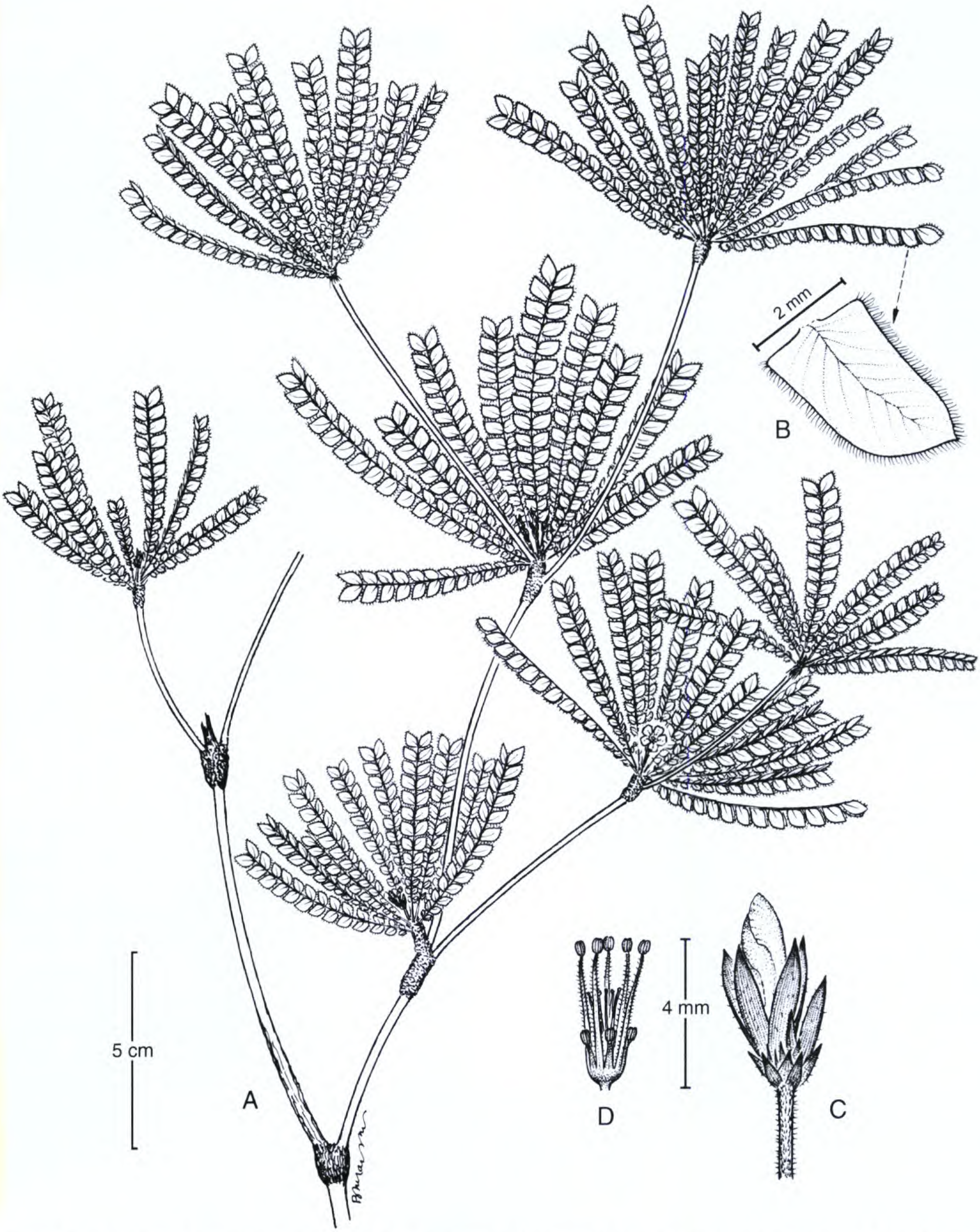

Figure 2. *Biophytum lourteigiae* Aymard & P. E. Berry. —A. Habit. —B. Leaflet showing the lower surface and ciliate margins on young leaves. —C. Flower in bud showing the bracteoles. —D. Flower (mid-style form) with sepals and petals removed, showing the middle position of the styles between the two whorls of stamens. Drawn from the holotype, *G. Aymard & L. Delgado 8345* (PORT).

hispid-pubescent; styles 5, ca. 1 mm long, glabrous, appressed-pubescent at the base; stigmas capitate. Capsules 5-lobed, ca. 3 mm long, glabrous except densely appressed-pubescent at the apex; carpels 1-seeded; seeds ellipsoidal, ca. 2 mm long, glabrous, slightly striate.

Habitat and distribution. *Biophytum lourteigiae*

is known from white-sand areas to the south and west of Cerro Duida, Amazonas state in Venezuela, occurring in the moist understory of evergreen lowland (or occasionally lower montane) forests. Except for one specimen collected at 1000 m elevation (*Liesner 25351*), the rest were found between 140 and 210 m.

Biophytum lourteigiae is morphologically close to *B. ferrugineum* Rusby, from Bolivia, and *B. kayae* from Venezuela. It differs from *B. ferrugineum* in its smaller flowers (sepals sparsely pubescent and 3–3.5 mm long vs. densely pilose and ca. 6 mm long; petals 4–5 mm long vs. ca. 8 mm long), lightly pubescent (vs. ferrugineous) bracteoles, and smaller leaflets (3–6 × 2–4 mm vs. 6–12 × 4–5 mm). Compared to *B. kayae, B. lourteigiae* is a larger plant (to 1.5 m tall), with longer leaves (6–10 × 4–6 cm), more chartaceous (vs. coriaceous) leaflets that have inconspicuous venation on the upper surface, and capsules that are apically densely appressed-pubescent (vs. glabrous).

Paratypes. VENEZUELA. **Amazonas:** Río Cunucunuma, entre las bases de los cerros Duida y Huachamacari, 03°40′N, 65°45′W, 180–210 m, 28–30 Jan. 1982, *J. Steyermark et al. 125838, 126263* (NY, VEN); Río Cunucunuma, Caño Negro, 200 m, *J. Peréz & M. Sosa 28* (TFAV); Culebra, Río Cunucunuma, 03°40′N, 65°45′W, *J. Steyermark & F. Delascio 129140* (TFAV, VEN); Culebra, Río Cunucunuma, 03°44′N, 65°44′W, 210 m, *R. Liesner 17520, 24553* (MO, PORT); Río Negro, afluente del Río Cunucunuma, 03°43′N, 65°39′W, 210 m, *A. Fernández 7649* (MO, PORT), *A. Fernández et al. 8175* (PORT); between Duida and Marahuaca, near base of Cerro Duida, 03°34′N, 65°32′W, 1000 m, *R. Liesner 25351* (MO, PORT).

This species is named in honor of Alicia Lourteig for her extensive taxonomic work on Oxalidaceae. In the *Flora of the Venezuelan Guayana* treatment of Oxalidaceae (Aymard & Berry, 2003), this species was treated as "*Biophytum* sp. *A*."

Biophytum ottohuberi Aymard & P. E. Berry, sp. nov. TYPE: Venezuela. Bolívar: Distrito Cedeño, Serranía Guanay, sector nororiental, cabeceras del Río Parguaza, 05°55′N, 66°23′W, 1700 m, 20–28 Oct. 1985, *O. Huber 10963* (holotype, MYF; isotypes, NY, VEN not seen). Figure 1D–F.

Biophyto dormienti affinis, sed foliolis rigide coriaceis supra glabris, marginibus incrassatis, obovato-obdeltoideis vel late oblongis, 5–9 jugatis, floribus sessilibus, petalis pallide purpureis et ovariis adpresse pilosis recedit.

Shortly branched subshrub, the main stem 30–50 cm tall and 5–8 mm in circumference at thickest point, erect; branches and branchlets densely appressed-pubescent, sparsely pubescent to glabrescent when mature. Leaves 10 to 20 per cluster, 5- to 9-jugate, rachis 2–6 cm long, densely barbate when young, glabrescent; leaflets sessile, 1–4 × 1–3 mm, asymmetric, obovate-obdeltate to broadly oblong, rigid-coriaceous, strongly reticulate and glabrous on upper surface, lower surface papillate and with inconspicuous venation, 18- to 24-veined, the base truncate, the apex broadly rounded, margins thickened, ciliate when young, glabrescent. Inflorescence subterminal, globose, sessile or subsessile, peduncle 0–1 mm long, appressed-pubescent; bracteoles ca. 10, clustered, setaceous, ca. 1 mm long, sparsely pilose on both sides, ciliate at the margins. Flowers examined (from the type collection) consistent with the mid-styled floral morph (if tristylous), sessile; sepals lanceolate, ca. 3 mm long, 8- to 12-nerved, subglabrous, margins glandulose-ciliate; petals pale purple, obovate, ca. 4 mm long, glabrous, 5- to 7-nerved; longer stamens ca. 2 mm long, filaments pilose, the shorter ones ca. 0.5 mm long, filaments glabrous, the anthers ovoid, ca. 0.3 mm long; ovary 5-lobed, 0.8–1 mm long, appressed-pilose; styles 5, pilose, 0.3–0.5 mm long; stigmas capitate. Capsules 5-lobed, ca. 3 mm long, appressed-glandulose to pilose, carpels 1-seeded; seed ellipsoidal, ca. 2 mm long, sparsely ciliate, slightly striate.

Habitat and distribution. *Biophytum ottohuberi* is known only from the type collection, in low forests in sandstone rocky areas around 1700 m elevation on the summit of Cerro Guanay, a tepui near the border of Amazonas and Bolívar states, Venezuela.

In its small leaflets and nearly sessile inflorescence, *Biophytum ottohuberi* is similar to *B. dormiens* (Martius & Zuccarini) Knuth from the Rio Negro area of Amazonas state in Brazil (Zuccarini, 1825; Knuth, 1919). However, *B. ottohuberi* differs from that species in the following ways: its leaflets are obovate-obdeltate to broadly oblong, glabrous on the upper surface, 5- to 9-jugate, and with thickened margins (in *B. dormiens* the leaflets are obliquely rhomboid, appressed-pubescent on the upper surface, less coriaceous, 17- or 18-jugate, and the margins are not thickened). Also, the flowers of *B. ottohuberi* are sessile, with pale purple petals and an appressed-pilose ovary, while in *B. dormiens* the flowers have pedicels 1–2.5 mm long, white petals, and the ovary is glabrous or at most apically pilose.

The species is named after Otto Huber, who collected the type and made many unique and valuable collections from the tepuis of the Venezuelan Guayana. In the *Flora of the Venezuelan Guayana*

treatment of Oxalidaceae (Aymard & Berry, 2003), this species was treated as "*Biophytum* sp. *B.*"

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Hippeophyllum microphyllum, a New Species of Orchidaceae from Papua New Guinea

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ABSTRACT. *Hippeophyllum microphyllum* S. C. Chen, a new species of Orchidaceae from Papua New Guinea, is described and illustrated. It is distinct from the other *Hippeophyllum* by having very narrow leaves 1.5–2 mm wide, minute flowers less than 1 mm across, and irregularly serrate-margined petals.

Key words: Hippeophyllum, Oberonia, Orchidaceae, Papua New Guinea.

Hippeophyllum Schlechter is a small genus with 13 species known from Malaysia, Indonesia, Papua New Guinea, the Philippines, and China. The genus is closely related to *Oberonia* Lindley by leaf characters and floral structure, but differs by having a creeping, elongate rhizome, on which the equitant-leaved stems appear at a certain distance apart.

The orchid described here occurs in Papua New Guinea. It is remarkable for its very narrow leaves 1.5–2 mm wide, minute flowers less than 1 mm across, and irregularly serrate-margined petals. These are all rare features in *Hippeophyllum*, by which the new species is easily distinguishable from the other members of the genus. It is of interest that *H. microphyllum* is similar in floral structure, such as bilobed lip with 2 basal auricles and irregularly serrate-margined petals, to some species of *Oberonia*, such as *O. ensiformis* (Smith) Lindley, rather than those of *Hippeophyllum*. It may not be appropriate to separate *Hippeophyllum* from *Oberonia* based merely on whether or not the creeping rhizome is present.

Hippeophyllum microphyllum S. C. Chen, sp. nov. TYPE: Papua New Guinea. Vogelkop Peninsula, Ije River valley, path from Banfot to Sudjak, alt. 840 m, 3 Nov. 1961, *P. van Royen & H. Sleume 7662* (holotype, K). Figure 1.

Haec species insignis a congeneris nobis notis foliis angustissimis (1.5–2.0 mm latis), floribus minutis 0.8 mm in diam. atque petalis margine irregulariter serratis bene distincta est.

Plants epiphytic, glabrous; rhizome elongate, creeping, 3–6 cm long, 1–1.5 mm diam., remotely noded; sheaths membranous, translucent, cylindric, 2 mm long; roots 2 or 3 at the bottom of each equitant-leaved stem; stems 5–10(–15) mm apart, 1–1.5 cm long, 4- to 6-leaved. Leaves laterally compressed, equitant, subfalcate-linear, 1–3 cm × 1.5–2 mm, light green, long-acuminate at apex, broadly membranous-margined toward the base, obscurely articulate. Scape 3–4.5 cm long, terminating in a many-flowered raceme; peduncle 2–3 mm long; bracts linear, membranous, translucent, 0.8 × 0.2 mm; pedicel with ovary 0.5 mm long, not resupinate. Flowers ca. 0.8 mm across, red; sepals broadly ovate-elliptic, 0.5 × 0.4 mm, obtuse; petals narrowly elliptic-lanceolate, 0.5 × 0.2 mm, acuminate, irregularly serrate at the margin; lip broadly ovate-oblong in outline, 0.45 × 0.4 mm, constricted near the middle and bilobed at apex, forming two basal auricles and two apical lobes; auricles and lobes erose at the margins; column ca. 0.1 mm long, dilated at apex. Capsule ellipsoid, 2 × 1.7 mm.

This new species is known only from the type locality, at an elevation of 840 m, growing on dead wood in an oak forest. So far as we know, most species of *Hippeophyllum* and *Oberonia* grow high up on trees or cliffs, and they are usually invisible and inaccessible. The species described here is the smallest plant in the genus. Its poor collection seems due to being difficult to access or invisible rather than rarity.

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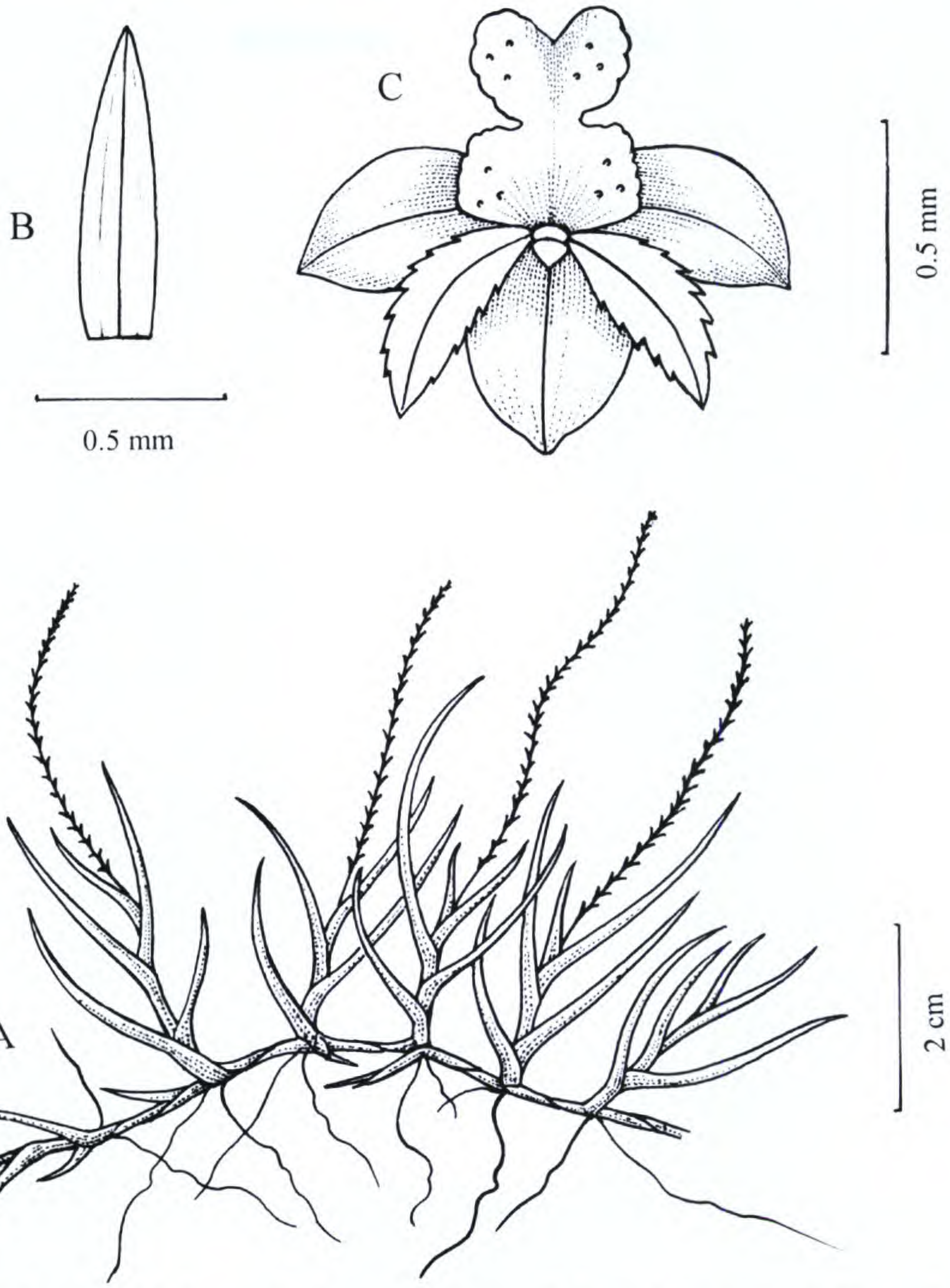

Figure 1. *Hippeophyllum microphyllum* S. C. Chen. —A. Plant. —B. Bract, front view. —C. Flower. Drawn from the holotype.

A New Combination in *Psilanthus* (Rubiaceae) for Australasia, and Nomenclatural Notes on *Paracoffea*

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ABSTRACT. The combination *Psilanthus brassii* (J.-F. Leroy) A. P. Davis, based on the basionym *Paracoffea brassii* J.-F. Leroy, is proposed. Herbarium research shows that *Psilanthus brassii* (Rubiaceae, Coffeeae) occurs in northeastern Australia and Papua New Guinea. Nomenclatural notes on the genus *Paracoffea* J.-F. Leroy, a generic synonym of *Psilanthus* Hooker f., are provided.

Key words: Australia, *Coffea*, coffee, Coffeeae, Papua New Guinea, *Paracoffea*, *Psilanthus*, Rubiaceae.

The genus *Paracoffea* was described by Leroy (1967) to accommodate a group of 19 species from Africa, Madagascar, and Asia, most of which were previously placed in *Coffea* L. (e.g., see Chevalier, 1947). According to authors working on *Coffea* and related genera, for example, Bridson (1987: 454) and Robbrecht (1981: 359), the genus was not validly published. The contentious point in the valid publication of *Paracoffea* (Bridson, pers. comm.) was that Leroy's new combination (based on *Coffea* sect. *Paracoffea* Miquel) did not cite the full reference for the basionym. However, in the publication of *Paracoffea* (Leroy, 1967) the genus name is followed by "gen. nov." and a Latin diagnosis: Leroy is describing a new genus and not making a new combination. The holotype is given as *Coffea* sect. *Paracoffea* Miquel, which provides an indirect reference to the type (ICBN: Art. 37.3; Greuter et al., 2000); in a footnote of a later paper (Leroy, 1968b: 606), a direct reference to the type species of *Paracoffea* is given (i.e., *Coffea horsfieldiana* Miquel). *Paracoffea* J.-F. Leroy is thus validly published.

In the same publication as *Paracoffea*, Leroy (1967) proposed 19 species-level combinations and three new subgenera for *Paracoffea* (subg. *Insulanoparacoffea*, subg. *Afroparacoffea*, and subg. *Melanoparacoffea*; see Appendix 1). However, all these names are invalid because the basionyms for the new combinations are not provided, and the subgenera are unaccompanied by descriptions or reference to published descriptions. Leroy's 19 invalid combinations in *Paracoffea* represent species now placed in *Psilanthus*, *Coffea* subg. *Baracoffea*, and *Prismatomeris* Thwaites (see below). Shortly afterward, Leroy added two more species to *Paracoffea*: *P. brassii* J.-F. Leroy from Papua New Guinea (Leroy, 1968a) and *P. floresiana* (Boerlage) J.-F. Leroy from Flores, Indonesia (Leroy, 1968b). *Paracoffea merguensis* (H. N. Ridley) J.-F. Leroy, an additional Asian species, was added several years later (Leroy, 1972).

After consideration of African *Coffea* relatives, Leroy (1980a, 1980b) decided to place most species of *Paracoffea* into the genus *Psilanthus* Hooker f., as he considered these two genera to be congeneric. Leroy (1980a) proposed the recognition of *Psilanthus* subg. *Paracoffea* (Miquel) J.-F. Leroy (based on *Coffea* sect. *Paracoffea* Miquel) for species from Africa, Asia, and New Guinea that were formerly placed in the genus *Paracoffea*. Unfortunately, Leroy overlooked *Coffea* subg. *Afrocoffea* Moens (1962), which predates and competes with the use of *Paracoffea* at subgeneric rank (Bridson, 1987; and see Appendix 1). The placement of *Paracoffea* species in *Psilanthus* subg. *Afrocoffea* has been upheld by those working on the taxonomy of *Coffea* and *Psilanthus* (e.g., Bridson, 1987, 1988a, 1988b; Sivarajan et al., 1992; Stoffelen et al., 1997; Stoffelen, 1998). Four of Leroy's (1967) 19 invalid combinations in *Paracoffea* (viz. "*P. grevei*," "*P. humbertii*," "*P. capuronii*," and "*P. decaryana*") were later placed in *Coffea* subg. *Baracoffea* (Leroy, 1980a, 1980b, 1981); "*Paracoffea malayana*" has been assigned to *Prismatomeris*, provisionally as *P.* sp. (Wong, 1989).

Where appropriate (i.e., excluding *Coffea* subg. *Baracoffea*) Leroy made combinations in *Psilanthus* for the species that he had previously placed in *Paracoffea* (Leroy, 1981; Lobreau-Callen & Leroy, 1980) except for *Paracoffea brassii* (as indicated by Bridson, 1987). *Paracoffea brassii* possesses the key features of *Psilanthus* subg. *Afrocoffea*, including: seasonally indeterminate axillary inflorescences (followed by terminal inflorescences via the production of relay axes); stiff and awn-like stipular lobes on the middle calyculus (see Davis & Rak-

otonasolo, 2000, for inflorescence terminology); leaf-like lobes on the upper calyculus; a long corolla tube (more than three times longer than the lobes); anthers included; style very short (lobes positioned distinctly below anthers at the base of the corolla tube); and a laterally compressed fruit.

Based on the above evidence, I propose the following new combination in *Psilanthus*.

Psilanthus brassii (J.-F. Leroy) A. P. Davis, comb. nov. Basionym: *Paracoffea brassii* J.-F. Leroy, J. Agric. Trop. Bot. Appl. 14: 598. 1967 [1968]. TYPE: Papua New Guinea. Central Province: Baroka, Nakeo District, 30 m, 8 Apr. 1933, *L. J. Brass 3743* (holotype, BO; isotype, A).

Distribution and habitat. Papua New Guinea (Central Province) and Australia (Torres Strait Island and Queensland). Monsoon forest, deciduous monsoon scrublands, deciduous vine thicket, and vegetation on stabilized dunes; elevation 15–150 m.

Phenology. Flowering September to December; fruiting February to May.

Conservation status—IUCN Red List Category. **Least Concern** (LC). This is a relatively widespread species, although low collecting frequency infers that further work is required to assess local vulnerability.

Additional material examined. PAPUA NEW GUINEA. **Central Province:** Tovobada Hills, ca. 9 mi. [15 km] NNW of Port Moresby, ca. 500 ft. [152 m], 14 May 1967, *Pullen 6980* (A, BO, BRI, CANB, K, L, LAE, US); near SE side of Little Mount Lawes, ca. 16 mi. [26 km] N of Port Moresby, ca. 150 ft. [46 m], 25 Apr. 1967, *Pullen 6814* (A, BRI, CANB, K, L, LAE); Kanosia, ca. 50 ft. [15 m], 9 Feb. 1935, *Carr 11220* (K); Port Moresby subdistrict, below Vetorogu Hill, Tovobada Peaks, 3 km N of Barune, 60 m, 24 May 1974, *Frodin & Field Botany Class UPNG 4323* (K). AUSTRALIA. **Torres Strait Is.:** Sunday Island, June 1821, *Cunningham 7* (K); Sunday Island, s.c. s.n. (K). **Queensland:** Cook District, 1 km S of Sieisia, 21 Nov. 1999, *Wannan NSW 443387* (BRI, NSW).

Notes. *Psilanthus brassii* is similar to *P. mabesae* (Elmer) J.-F. Leroy from the Philippines, but differs in that its leaves, flowers (corolla), and fruits are glabrous (not puberulous to pubescent as in *P. mabesae*). Herbarium and literature studies indicate that *P. brassii* is the only species of *Psilanthus* occurring in Papua New Guinea and Australia.

Acknowledgments. The author thanks K. Challis, R. K. Brummitt, D. Bridson, and G. Zijlstra for careful guidance with nomenclatural aspects of this paper. The directors and staff at the following herbaria are acknowledged for their assistance with access to herbarium collections: BO, CANB, L, and NSW.

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Appendix 1. Outline classification of *Coffea* and *Psilanthus.*

Coffea L., Sp. Pl.: 172. 1753.

Coffea subg. **Coffea** L. TYPE: *Coffea arabica* L.
Around 90 species. Africa, Madagascar, Mascarenes.
Coffea subg. *Psilanthopsis* (A. Chevalier) J.-F. Leroy, Ass. Sci. Internat. Café, (ASIC) 9th Colloque: 475. 1980. *Psilanthopsis* A. Chevalier, J. Agric. Trop. Bot. Appl. 19: 404. 1939. TYPE: *Coffea kapakata* (A. Chevalier) Bridson.
Monotypic. Africa (Angola).
Paolia Chiovenda, Result. Sci. Miss. Stenfan. -Paoli Somal. Ital. 1: 93. 1916. TYPE: *Paolia jasminoides* Chiovenda (= *Coffea rhamnifolia* (Chiovenda) Bridson).
Monotypic. Africa (Somalia and Kenya).

Coffea subg. **Baracoffea** (J.-F. Leroy) J.-F. Leroy, Ass. Sci. Internat. Café, (ASIC) 9th Colloque: 475. 1980. *Coffea* sect. *Baracoffea* J.-F. Leroy, Comp. Rend. Acad. Sci. Paris 252: 2287. 1961. TYPE: *Coffea humbertii.*
Seven species (including four undescribed). Madagascar.

[*Paracoffea* subg. *Insulanoparacoffea* J.-F. Leroy, J. Agric. Trop. Bot. Appl. 14: 276 (1967), nom. nud.]

Psilanthus Hooker f., Gen. Pl.: 115. 1873.

Psilanthus subg. **Psilanthus** Hooker f. TYPE: *Psilanthus mannii* Hooker f.
Two species. Africa (central and western).

Psilanthus subg. **Afrocoffea** (Moens) Bridson, Kew Bull. 42: 454. 1987. *Coffea* subg. *Afrocoffea* Moens, Bull. Jard. Bot. Brux. 32: 131. 1962. TYPE: *Psilanthus lebrunianus* (Germain & Kesler) Bridson.
About 17 species. Africa, Asia, Australasia.
Coffea sect. *Paracoffea* Miquel, Fl. Ind. Batavae: 308. 1856. *Psilanthus* subg. *Paracoffea* (Miquel) J.-F. Leroy, Ass. Sci. Internat. Café, (ASIC) 9th Colloque: 475. 1980. TYPE: *Coffea horsfieldiana* Miquel.
Paracoffea J.-F. Leroy, J. Agric. Trop. Bot. Appl. 14: 276. 1967. TYPE: *Coffea horsfieldiana* Miquel.
[*Paracoffea* subg. *Afroparacoffea* J.-F. Leroy, J. Agric. Trop. Bot. Appl. 14: 276 (1967), nom. nud.]
[*Paracoffea* subg. *Melanoparacoffea* J.-F. Leroy, J. Agric. Trop. Bot. Appl. 14: 276 (1967), nom. nud.]

Two New Species of *Streptocarpus* (Gesneriaceae) from South Africa

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Abstract. A new species of the *Streptocarpus rexii* aggregate is described from Itala Game Reserve in KwaZulu-Natal, South Africa. The geographic isolation of *S. kunhardtii*, its pale methyl violet flowers, and long fruits distinguish it from *S. roseoalbus*, its closest relative. A second new species, *S. hilburtianus*, is described from two high-altitude localities in Mapumalanga, South Africa. The alliances of this species are unclear, although corolla coloration and leaf vestiture approach *S. galpinii*; however, it differs in its cylindrical corolla tube, its much shorter pedicels, and its distinctive pollen.

Key words: Gesneriaceae, South Africa, *Streptocarpus*.

The recognition of species limits within *Streptocarpus* Lindley is complicated by the lack of fertility barriers between species of the typical subgenus. This feature has considerable impact on species concepts for the genus and heightens the importance of allopatry in the speciation process. For the most part, *Streptocarpus* species are limited to forest patches that have shrunk and expanded, with climatic vicissitudes, through geological history. Over the last 2 million years, southern Africa has experienced 20 climatic cycles, each lasting ca. 100,000 years (Deacon, 1983; Tyson, 1986; Deacon & Lancaster, 1988). The resulting fragmentation of populations produces a powerful driving force for allopatric speciation, which in my opinion has been fundamental in the divergence of *Streptocarpus* (see Weigend & Edwards, 1994a, 1994b).

1. Streptocarpus kunhardtii T. J. Edwards, sp. nov. TYPE: South Africa. KwaZulu-Natal: Itala Nature Reserve, Mpophomeni Gorge, S-facing cliffs, 14.12.1996, *C. Carbutt 35* (holotype, NU; isotypes, E, MO, PRE).

Haec species ad gregem *Streptocarpi rexii* pertinens quoad corollae formam notasque ad *S. roseoalbum* maxime accedit, sed ab eo foliis majoribus plerumque suberectis, fructu majore atque lobulis corollinis inferioribus pallide malvicoloribus distinguitur.

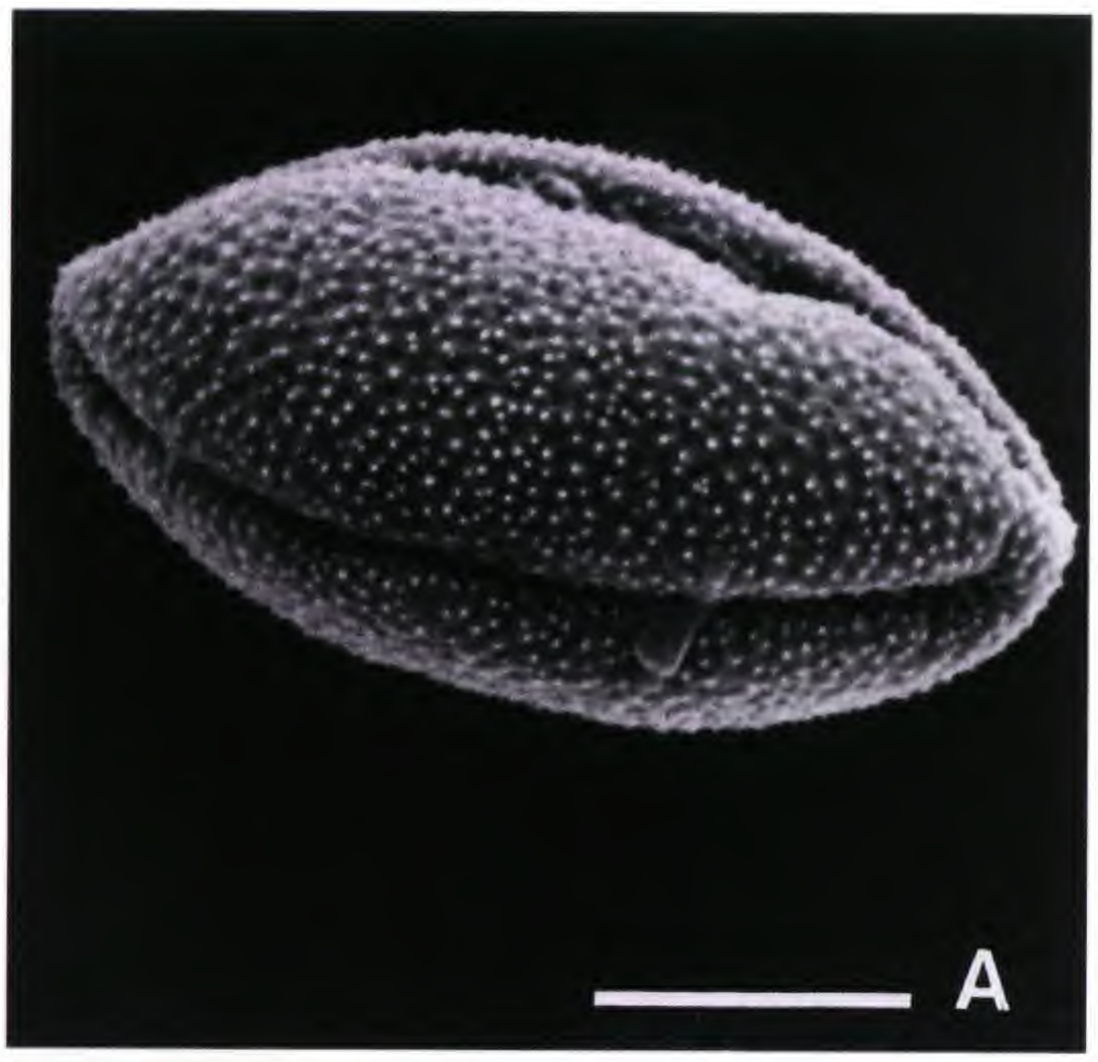
Perennial rosulate, rhizome poorly developed. *Leaves* suberect, up to 120–250 × 40–55 mm, margin crenate, base cuneate, decurrent on the petiole; petiolode 10–15 × 6–8 mm, red-brown to green, pilose. *Inflorescence* 1- or 2(to 4)-flowered; pilose with glandular and filiform trichomes throughout; peduncle up to 100–240 mm, maroon to green; bracts lanceolate, 2–3 × 0.75 mm; pedicel 9–15 mm. *Calyx* segments linear, 5.5–6.5 mm, glandular pilose. *Corolla* broadly infundibuliform, tube white, 24–29 × 3 mm broadening to 10 mm in the throat, bent in the lower third; pilose with glandular and filiform trichomes on the outside; yellow stripe on the tube floor sometimes broadened in the basal third; lower limb 15–20 mm long, lobes 10–15 × 10–12 mm, pale methyl violet (Wilson, 1941) with darker central stripes; upper lobes 7–13 × 10–11 mm. *Stamens* 2; filaments 8–9 mm, white, with stalked glandular trichomes; anthers connate; staminodes 2–3 × 0.5 mm, glabrous. *Pollen* prolate, 17–20 × 9–10 μm, tricolpate; mesocolpium diffusely perforate, scabrate (Fig. 1). *Ovary* 10–14 mm long, densely pubescent, green; style 8–12 mm long, glandular, white. *Fruit* 80–110 × 2.5 mm. *Seeds* 0.5–0.7 mm long, sculpturing reticulate.

Distribution. Chris Kunhardt collected this rosulate *Streptocarpus* from Itala Game Reseve in the 1980s, shortly before his death. Vague provenance details of the population were kept in his living collection, and relocation of the population proved difficult. Recently the species was rediscovered at Itala Nature Reserve (*Carbutt 35*) in sparse populations, deeply shaded on south-facing cliffs, usually near streams of the Mpophomeni Gorge.

Phenology. The species flowers through December and January, fruiting between December and February.

Etymology. The species epithet honors its discoverer, the late Chris Kunhardt, an avid amateur botanist and *Streptocarpus* enthusiast.

Corolla morphology and color patterning suggest an alliance with *S. roseoalbus* Weigend & T. J. Edwards, which occurs in Lowveld vegetation (Acocks, 1988) around Barberton (Mpumalanga). In



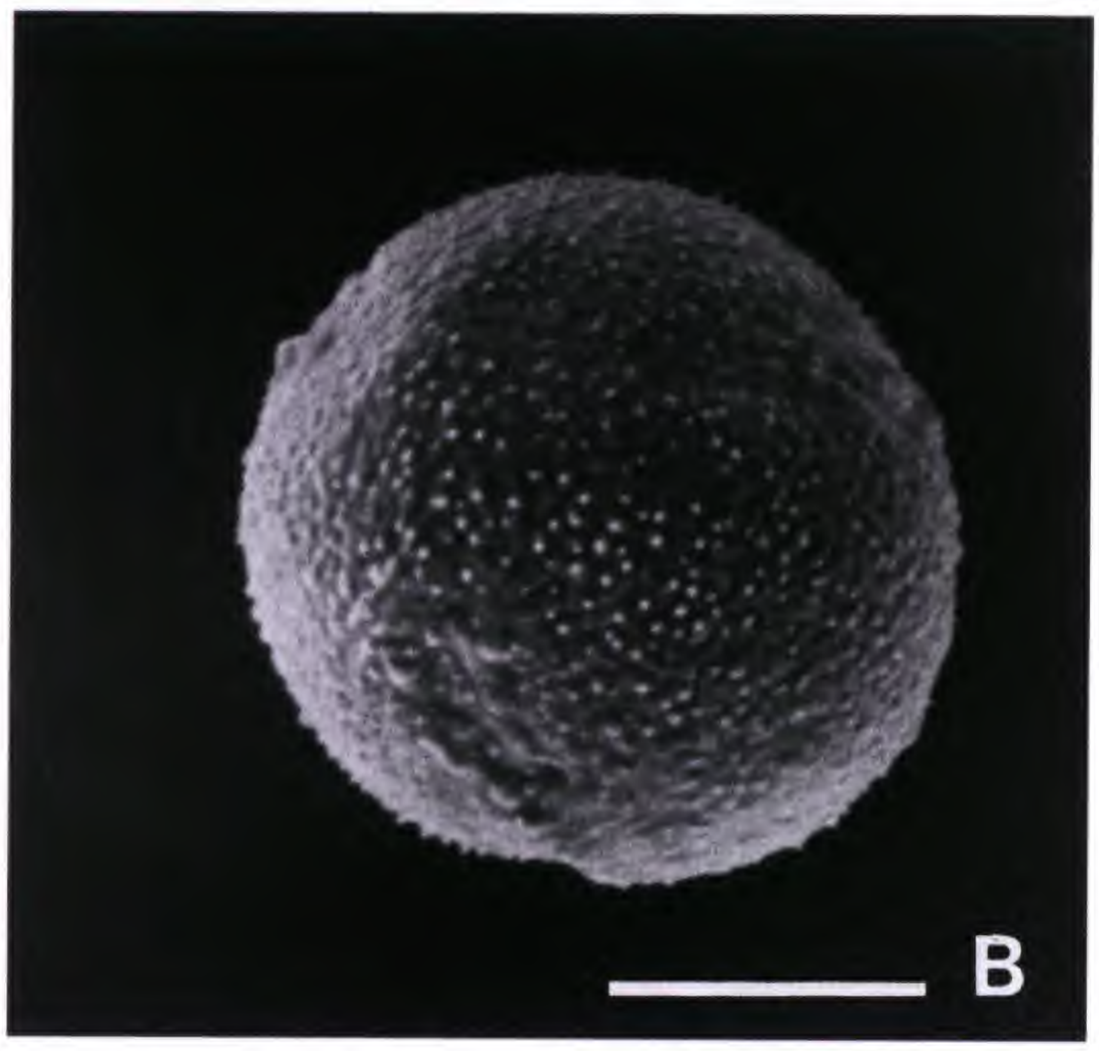


Figure 1. Pollen micrographs. —A. *Streptocarpus kunhardtii* (*Carbutt 35*). Scale bar 6 μm. —B. *Streptocarpus hilburtianus* (*Edwards 682*). Scale bar 5 μm.

S. roseoalbus the corolla is 34–45 mm long with a short tube of 25–30 mm; its proximal width is 3 mm broadening to 9–10 mm in the throat. Corolla color is, however, distinctive: *S. roseoalbus* is always pink and *S. kunhardtii* is always methyl violet. The leaves of *S. roseoalbus* are small and more or less prostrate, while in *S. kunhardtii* leaves are usually suberect. In addition, the mature fruits of *S. roseoalbus* are significantly shorter than those of the new species, never exceeding 55 mm.

Streptocarpus kunhardtii further plugs the disjunctions between the closely allied rosulate *Streptocarpus* species of the eastern seaboard of South Africa: its morphology closely approximates these species, and its pollen is indistinguishable (Weigend & Edwards, 1996).

Paratypes. SOUTH AFRICA. **KwaZulu-Natal:** 2731 (Louwsburg) Itala Game Reserve (CB), 14 Dec. 1996, *R. Scott Shaw 8597* (MO).

2. Streptocarpus hilburtianus T. J. Edwards, sp. nov. TYPE: South Africa. Mpumalanga: Long Tom Pass, Die Geut, 09.12.1992, *T. J. Edwards 682* (holotype, NU). Figure 2.

Haec species *Streptocarpo galpinii* similis, sed ab eo corollae tubo elongato cylindricoque labio inferiore ad basim macula alba luteave carente atque pedicellis brevioribus distinguitur.

Plants perennial. *Leaves* 1 to 3, prostrate, lamina 50–100 × 30–70 mm, base broadly cuneate, densely pilose, sericeous. *Inflorescence* cymose 2- to 10-flowered, lower flowers often sub-opposite; peduncle 50–140 mm long, densely glandular pilose; pedicels 10–14 mm long, densely glandular pilose; bracts spathulate, 2.5–3 × 0.5 mm. *Calyx* segments deltoid, 2.5–3 × 1.5 mm, slightly spreading, densely glandular pilose. *Corolla* 28–30 mm long, sparsely glandular pilose outside, glabrescent inside but sparingly pubescent on the floor; tube cylindric 18–23 mm, basal width 3–4 mm, mouth width 4.5–5 mm, deep mauve outside, white inside; lower lip 10 mm long, three-lobed, lobes 6 × 9 mm, pale mauve diluting to white in the throat, 2 mauve sinus chevrons sometimes present; upper lip 7 mm long, 2-lobed. *Stamens* 2, filaments arising in the lower third of the corolla tube, filaments 4–5 mm long, connective sparsely glandular pilose, anthers connate, 2 mm long; staminodes 2, 2–3 mm long, glabrous. *Pollen* spheroidal, 10–12 × 10–12 μm, tricolpate, colpi weakly verrucose, mesocolpi scabrate, apparently imperforate, poles apocolpate. *Gynoecium* 10–12 mm long; ovary 5–6 mm long, densely sericeous; style 5–6 mm long, pilose; stigma stomatomorphic. *Capsule* 25–30 × 2.5–3 mm, pilose.

Distribution. This species has only been collected twice, in Mpumalanga, South Africa. Populations occur at high altitudes (ca. 2000 m) on lithosols above cliffs in afromontane grasslands. The plants grow in very exposed positions, sparingly shaded by rock ledges and associated scrub.

Phenology. Flowering and fruiting collections of this species were made in November and December.

Etymology. The epithet is a combination of two names in recognition of the combined contributions made by O. M. Hilliard and B. L. Burtt to the systematics of *Streptocarpus*.

The niche and vegetative form of *S. hilburtianus* is similar to *S. galpinii* J. D. Hooker, but they are distinguished by pedicel length and corolla mor-

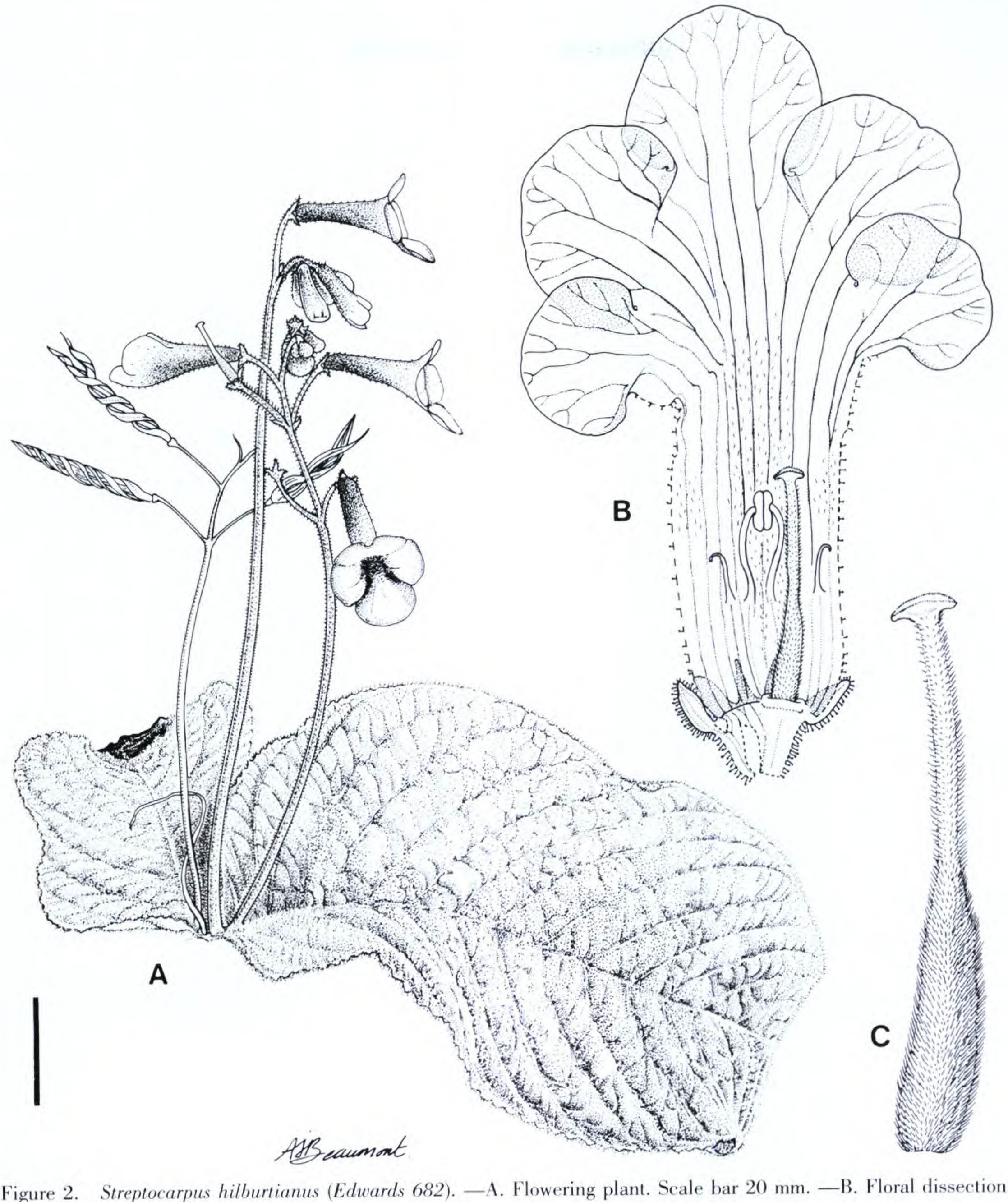


Figure 2. *Streptocarpus hilburtianus* (*Edwards 682*). —A. Flowering plant. Scale bar 20 mm. —B. Floral dissection. Scale bar 5 mm. —C. Gynoecium. Scale bar 2 mm. Drawn by A. J. Beaumont.

phology. In *S. hilburtianus* the pedicels are consistently shorter, 10–14 mm long, compared to 25–90 mm long in *S. galpinii*. The corolla of *S. galpinii* is distinctive for the genus, being short and open with a violet purple limb and a white patch, often colored with yellow, at the base of the lower lip. In contrast the new species has a cylindrical corolla tube usually with two chevrons of deep mauve flanking the medial lobe of the lower lip. The pollen of *S. hilburtianus* is unique in the genus (Fig. 1). The tectal ornamentation is very similar to that of the *S. rexii* aggregate but the grains are spheroidal and not prolate.

Paratype. SOUTH AFRICA. **Mpumalanga:** 2530 (Lydenburg) Hartebeesvlakte, *J. Kluge 2026* (PRE).

Acknowledgments. Jaco Truter is thanked for discussions on habitat and for tracking down the second population of *S. hilburtianus* at Hartebeesvlakte. Angela Beaumont contributed the line draw-

ing of *S. hilburtianus*. Clinton Carbutt and Rob Scott-Shaw are thanked for relocating the populations of *S. kunhardtii*. Mike Lambert is acknowledged for his continued assistance with Latin diagnoses, and I valued the improvements suggested by E. Hennessy. The research was funded by the National Research Foundation of South Africa and the University of Natal Research Fund.

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Two New Species of *Rhododendron* (Ericaceae) from China

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ABSTRACT. Two new species, *Rhododendron dayaoshanense* L. M. Gao & D. Z. Li from Guangxi, southern China, and *Rhododendron longilobum* L. M. Gao & D. Z. Li from Yunnan, southwestern China, are described and illustrated here. *Rhododendron dayaoshanense*, known only from Dayaoshan Mountain, Guangxi, is distinguished by the following characters: the leaves narrowly oblanceolate or oblong-lanceolate, short setose on undersurface and midrib, petiole densely glandular setose, pedicel densely gray-puberulent and glandular-pilose as well as ovary densely flavescent-tomentose. *Rhododendron longilobum* is collected only from Daweishan Mountain, southeast Yunnan, and is distinguished from its close relatives by the characters of the leaf blades with prominent lateral primary veins on both surfaces, calyx lobes membranaceous, linear, linear-lingulate or narrowly triangular, and 0.5–2 cm long; ovary densely flavescent tomentose and truncate at the apex.

Key words: China, Ericaceae, *Rhododendron*.

The two new species in this paper belong to *Rhododendron* subg. *Azaleastrum*, sect. *Choniastrum*, which is recognized by the following characters: evergreen shrubs or small trees; inflorescence buds lateral at the end of branches, 1- to several-flowered; corolla narrowly funnel-shaped, 5-lobed; stamens 10; ovary glabrous or pilose, cylindric, (5)6-locular. Section *Choniastrum* is comprised of about 14 species in China (He et al., 1994). Species of section *Choniastrum* are mainly distributed in southern China; only *R. taiense* Hutchinson is endemic to Thailand, and *R. moulmainense* Hooker f. extends southward to the Malay Peninsula and westward to Assam in India (Philipson & Philipson, 1986; Fang & Ming, 1995).

Rhododendron dayaoshanense L. M. Gao & D. Z. Li, sp. nov. TYPE: China. East Guangxi: Jinxiu Xian, Dayaoshan, alt. 1180 m, 2 May 2000 (fl), *L. M. Gao 20059* (holotype, KUN; isotype, KUN). Figure 1.

Species valde affinis *R. henryi* Hance, sed laminis foliorum oblanceolatis vel oblongo-lanceolatis, 8–13 cm longis, 1.8–2.5 cm latis, pedicellis dense cinereo-pubescentibus et sparsim glanduloso-pilosis; ovario dense flavescenti- tomentoso bene distincta.

Small tree, 3–4 m high; young branches slender, terete, glandular setose; mature branches brown, glabrous. Leaves clustering at the ends of branches, pseudo-verticillate; blade narrowly oblanceolate or oblong-lanceolate, 8–13 × 1.8–2.5 cm; apex acuminate, base cuneate, margin slightly revolute, midrib slightly depressed above and raised beneath, lateral veins 14 to 18 pairs, prominent on both surfaces, upper surface green, glabrous, undersurface pale green, short setae scattered on undersurface, dense on midrib. Petiole 0.8–1.5 cm long, grooved above, glandular setose. Inflorescence lateral, 4- to 5-flowered, umbellate; rachis brown, glabrous, 0.5 cm long; pedicels 2.5–3.5 cm long, densely gray pubescent and sparsely glandular pilose. Calyx rim undulate, lobes 5, triangular, ca. 1 mm long, glabrous. Corolla pale rose, narrowly funnelform, 5–5.5 cm long, glabrous outside; lobes 5, oblong-obovate or elliptic, 3.5–4 × 2.5–3 cm, tube 1.5–2 cm long, upper lobe with yellow blotch inside. Stamens 10, shortly exserted, filaments 4–4.5 cm long, puberulous in basal half but glabrate at base; anthers ovate, ca. 2 mm long, purple. Ovary oblong-cylindric, 7 mm long, densely flavescent tomentose. Style glabrous, 4–4.5 cm long; stigma green, capitate. Capsule not seen.

Distribution and habitat. The new species is known only from the type collection. It was found about 8 km east of Dayaoshan Mountain, Jinxiu county, east Guangxi Province, growing on a slope near the roadside, on the margin of mixed forest at ca. 1180 m altitude. Little plant collection has been done in the area. Thus it is not surprising that the species had not been collected before, and it is likely that it is not really rare on Dayaoshan Mountain.

Rhododendron dayaoshanense resembles *R. henryi* Hance in sharing 4 to 5 flowers per inflorescence, pink corolla, cylindric ovary, and tapering ovary apex. However, *R. dayaoshanense* differs from *R. henryi* in the leaves oblanceolate or oblong-lanceolate, calyces minute, glabrous, pedicel densely gray-puberulent and glandular-pilose, as well as

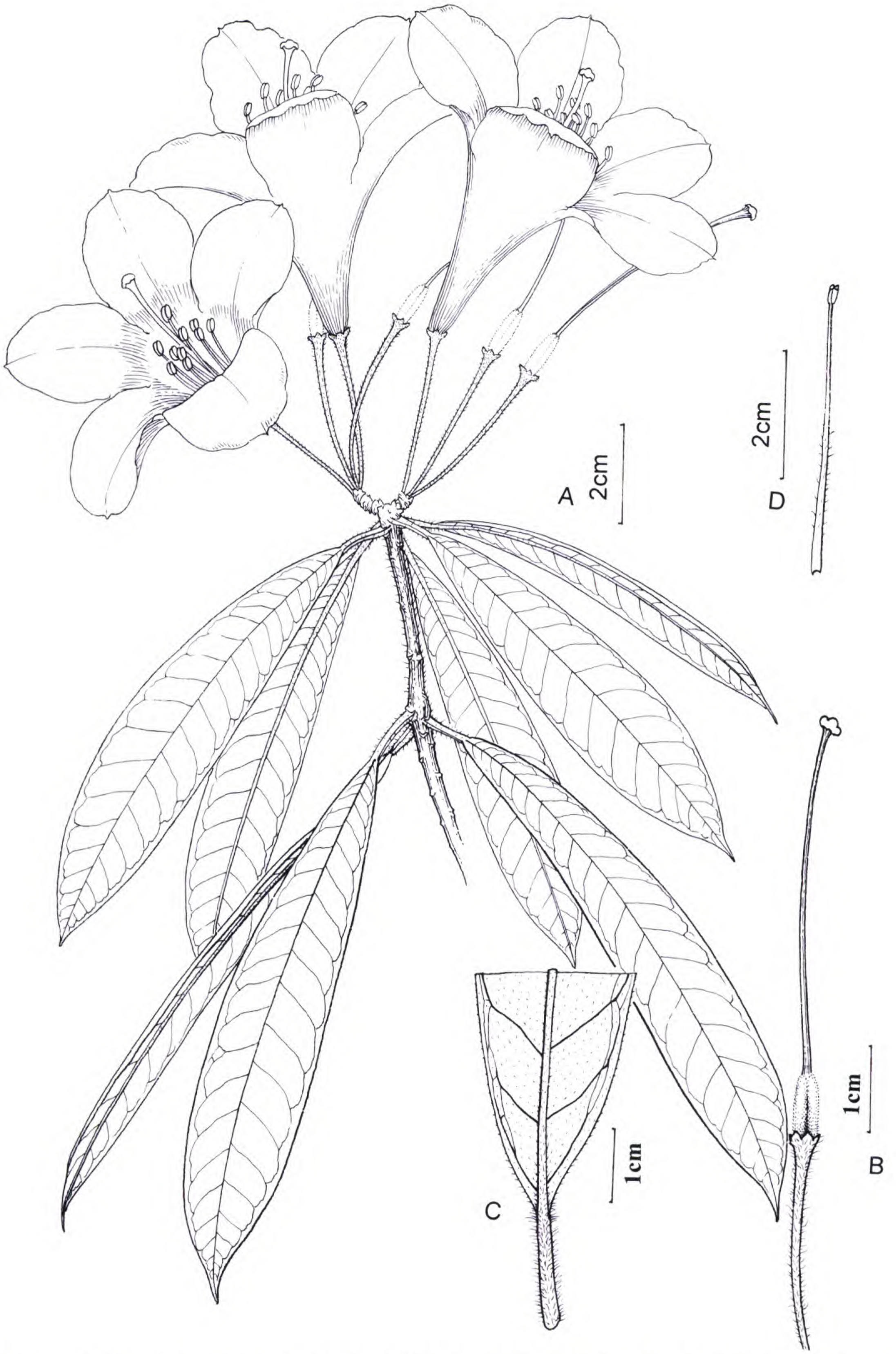

Figure 1. *Rhododendron dayaoshanense* L. M. Gao & D. Z. Li. —A. Flowering branch. —B. Pistil. —C. Basal portion of abaxial leaf surface. —D. Stamen. Drawn from the holotype (*L. M. Gao 20059*).

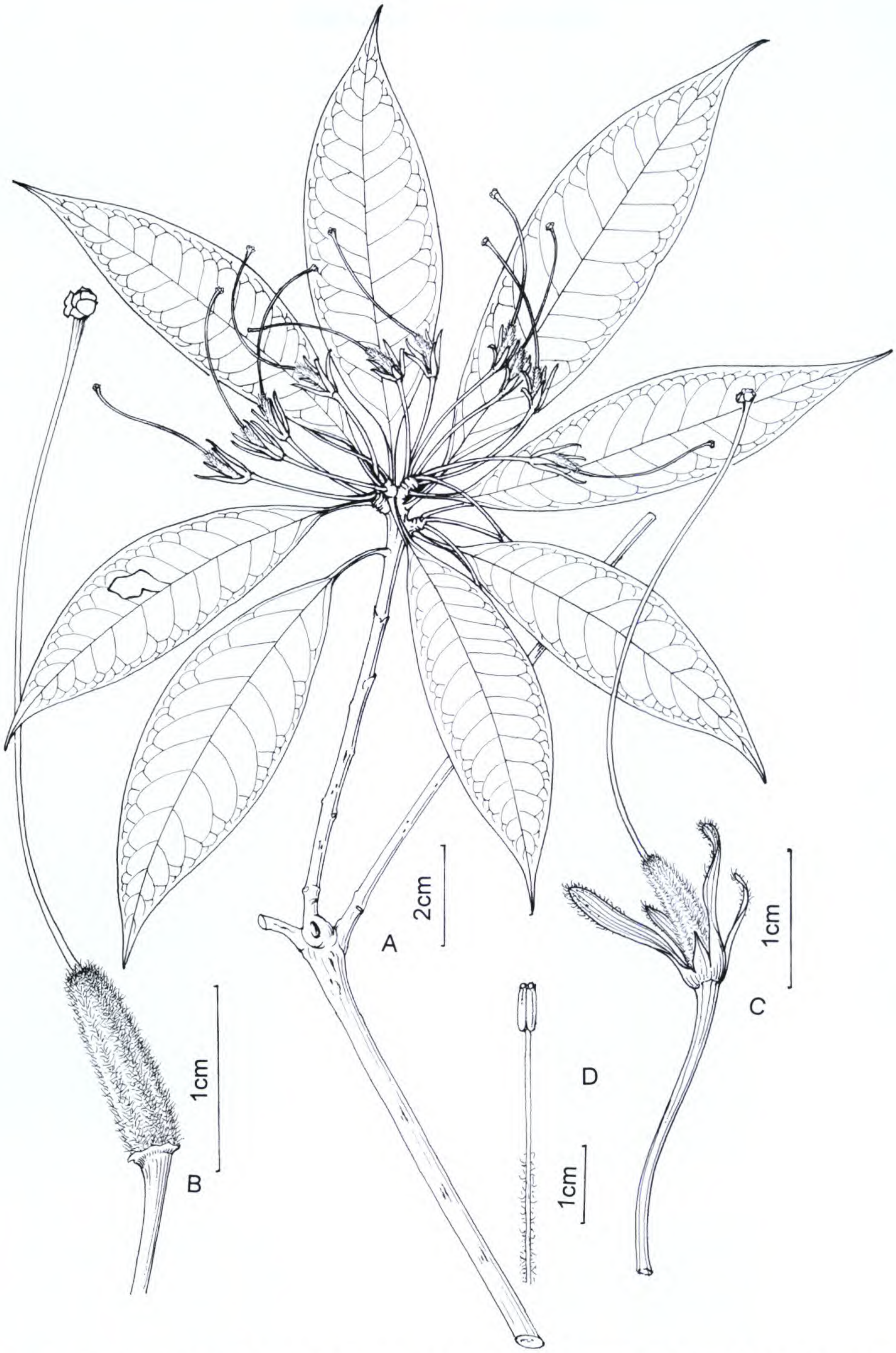

Figure 2. *Rhododendron longilobum* L. M. Gao & D. Z. Li. —A. Young fruit branch. —B. Pistil. —C. Pistil with calyx lobes. —D. Stamen. Drawn from the holotype (*Rhododendron Picture Group 83–0357*).

ovary densely flavescent-tomentose. *Rhododendron dayaoshanense* is also similar to *R. cavaleriei* in having 4 to 5 flowers per inflorescence, pedicel densely gray-pubescent, ovary densely flavescent-tomentose, and ovary apex tapering. However, the later species differs in the young branches glabrous, the leaves glabrous, the lateral primary veins inconspicuous, and petiole glabrous.

The new species is possibly a hybrid between *R. cavaleriei* Léveillé and *R. championae* Hooker f. because *R. dayaoshanense* is distributed together with *R. cavaleriei* and *R. championae* in this region and some characters of *R. dayaoshanense* were shared by *R. cavaleriei* and *R. championae*. The sequences of ITS and *TrnL-F* of *R. dayaoshanense* are the same as those of *R. cavaleriei* and *R. championae*.

Rhododendron longilobum L. M. Gao & D. Z. Li, sp. nov. TYPE: China. Southeast Yunnan: Pingbian Xian, Daweishan, near Shiuweicheng, alt. 1950 m, 9 May 1983, *Rhododendron Picture Group 83-0357* (holotype, KUN; isotype, KUN). Figure 2.

Species valde affinis *R. cavaleriei* sed laminis foliorum oblongis vel oblongo-ellipticis, nervis lateralibus foliorum utrinque conspicuis; lobis calycis membranaceis, 5–20 mm longis, 1 mm latis, linearibus vel lineari-lingulatis vel anguste triangularibus, ovario dense flavescenti-tomentoso, apice truncato differt.

Small trees, 6–8 m high; young branches terete, gray, glabrous. Leaves clustering at the ends of branches, pseudo-verticillate; blades elliptic or narrowly elliptic, ca. 7–10.5 × 1.8–2.5 cm, apex long acuminate, base cuneate, margin slightly revolute; upper surface green, under surface pale green, glabrous, midrib depressed above and raised beneath, lateral veins 12 to 16 pairs, prominent on both surfaces. Petioles 0.8–1.5 cm long, grooved above, glabrous. Inflorescences lateral, 4- to 5-flowered, umbrella clustering near the end of leafy shoot; outer bud scale gray pubescent, margin and apex minutely ciliate; rachis brown, ca. 0.5 cm long, glabrous; pedicels 2–2.5 cm long, glabrous. Calyx lobes 5, membranaceous, linear, linear-lingulate, or narrowly triangular, 5–20 × 1 mm, margins sometimes minutely ciliate and apical rim having tufts of long weak hairs. Corolla pale rose, narrowly funnelform, glabrous outside; lobes 5, 3–3.5 cm long, tube ca. 1 cm long. Stamens 10, shortly exserted, filaments 3–3.5 cm long, with puberulence on lower half; anthers ovate, ca. 2 mm long. Ovary narrowly cylindric, 7–12 mm long, densely flavescent tomentose, apex truncate; style glabrous, 3–3.5 cm long. Capsule not seen.

Distribution and habitat. The new species is probably rare as it is known only from the type collection, which occurs in evergreen broad-leaved forest, near the top of Daweishan Mountain at ca. 1950 m altitude, Pingbian County, southeast Yunnan province. This species occurs together with *R. tutcherae* Hemsley & E. H. Wilson, *R. moulmainense* Hooker f., and *R. hancockii* Hemsley of section *Choniastrum*. The habitat of the new species is very humid, which does not benefit growth and dispersion of seeds. It may be one of the reasons why this new species is rare at the type locality.

The species is easily distinguished from other species of section *Choniastrum* by the leaf blades with prominent lateral primary veins on both surfaces, the calyx lobes membranaceous, up to 2 cm long, and the ovary densely flavescent tomentose and truncate at the apex. *Rhododendron longilobum* is most similar to *R. cavaleriei* in having glabrous leaves, several flowers per inflorescence, and densely tomentose ovary. However, it differs from *R. cavaleriei* in having prominent lateral primary veins on both surfaces, the calyx lobes membranaceous and up to 2 cm long, and the ovary truncate at the apex. *Rhododendron kaliense* Fang & M. Y. He, *R. linearicupulare* Tam, *R. huguangense* Tam, and *R. longilobum* all have well-developed calyces, and the calyx lobes are variable in size. However, *R. longilobum* is easily distinguished from *R. kaliense*, *R. linearicupulare*, and *R. huguangense* by the characters of the ovary densely flavescent tomentose and truncate at the apex. The ovary is glabrous and tapering at the apex of *R. kaliense*, *R. linearicupulare*, and *R. huguangense*, which is different from *R. longilobum*.

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Primula calyptrata, a New Species in Section *Carolinella* (Primulaceae) from Yunnan, China

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ABSTRACT. *Primula calyptrata* X. Gong & R. C. Fang (Primulaceae) is described and illustrated. Analysis of its habitat, distribution, and capsule morphology indicates that this species is a member of *Primula* sect. *Carolinella* (Helmsley) Pax, which is endemic to humid subtropical regions of Yunnan, China, northern Vietnam, and Thailand, and characterized by an unusual calyptrate capsule.

Key words: China, *Primula*, Primulaceae, section *Carolinella*, Yunnan.

During an investigation of plants in southeastern Yunnan, China, in April 2001, some specimens of *Primula* were collected and recognized as a new species. After further studies, the species was believed to belong to section *Carolinella*. Living plants were introduced into Kunming Botanical Garden for cultivation and observation. Specimens were also collected by Shui Yu-min et al. from Zhongzai in Malipo County, Yunnan Province, in 2002.

Members of section *Carolinella* are unique in *Primula* for having a calyptrate capsule with a circumscissile lid, a feature also shared by the genera *Pomatosace* Maximowicz, *Anagallis* L., *Soldanella* L., and *Bryocarpum* Hooker f. & Thomson in Primulaceae (Pax & Knuth, 1905). The evolutionary trend of the fruits in Primulaceae is believed to be from indehiscent capsule to valvate capsule to calyptrate capsule with a circumscissile lid (Hu Q-M., 1994; Chen F-H. & Hu, 1990). This feature in section *Carolinella* is a link between *Primula* and the other genera; however, other morphological characters and distribution clearly separate them. The phylogenetic relationships among other sections in *Primula* and other genera of Primulaceae are still unclear because studies are lacking in chromosome number, pollen type, and seed morphology. The phenomenon that the calyptrate capsule occurs in the genera *Pomatosace*, *Anagallis*, *Soldanella*, and *Bryocarpum* in Primulaceae may be a result of convergent evolution (Kong & Liu, 1999).

Section *Carolinella* is believed to be a primitive group in *Primula* (Hu Q-M., 1994); this new taxon is considered to be primitive for having alternate and long-petioled leaves, 2–2.5 cm long stems, and homostylic flowers. In addition, *Primula* sect. *Carolinella* is a typical endemic of East Asia and is limited to southwestern and southern China and adjacent North Vietnam and Thailand. Eleven species were recognized in this section: almost all are stenochoric and have very small populations, some of which are in imminent danger. All of the species in this section occur in the warm-moist southern subtropical evergreen broadleaf forest of low altitudes within the limestone region.

Primula calyptrata X. Gong & R. C. Fang, sp. nov. TYPE: China. SE Yunnan: Malipo County, Xiajinchang, 1870 m, 16 Apr. 2001, *X. Gong 02815* (holotype, KUN). Figure 1.

Species in hac sectione caulibus brevibus, foliis subtus purpuratis valde differt. Planta *P. intanoensi* e Thailandia valde proxima, sed caulibus 2–2.5 cm longis, foliis alternantibus, corollis purpureis, tubis 1.7 cm longis, limbis 1.5–1.8 cm in diam., pedicellis 2–4 mm longis differt.

Herbs perennial, completely efarinose, stems and both surfaces of leaf blade as well as petioles with dense articulated hairs. Rhizome elongated, 2 cm long, with numerous fibrous roots, producing 1 or 2 leaf-bearing stems above. Stem 2–2.5 cm long before or in anthesis, purple. Leaves alternate, leaf blade suborbicular, 2.8–4 × 2.6–3.8 cm, apex rounded, base cordate, margin irregularly undulate, thick-papyraceous when dry, grayish green above, purple below, midrib and 4 pairs of lateral veins obscure above and plane but distinct below; petiole 2.5–5.5 cm long. Scape 1 or 2, 12–18 cm high, sparsely white villous, with 1 to 2 superimposed umbels with 2 to 5 slightly secund flowers in each; pedicels 2–4 mm long, with dense articulated hairs; bracts ovate-lanceolate, 4–6 mm long, prominently 1-nerved, with dense articulated hairs; calyx campanulate, 5–6 mm long, with dense articulated hairs, divided to 1/2–1/3 into ovate-triangular lobes, lobe with 3 distinct nerves; corolla purple with a yellow eye, salverform, pubescent outside,

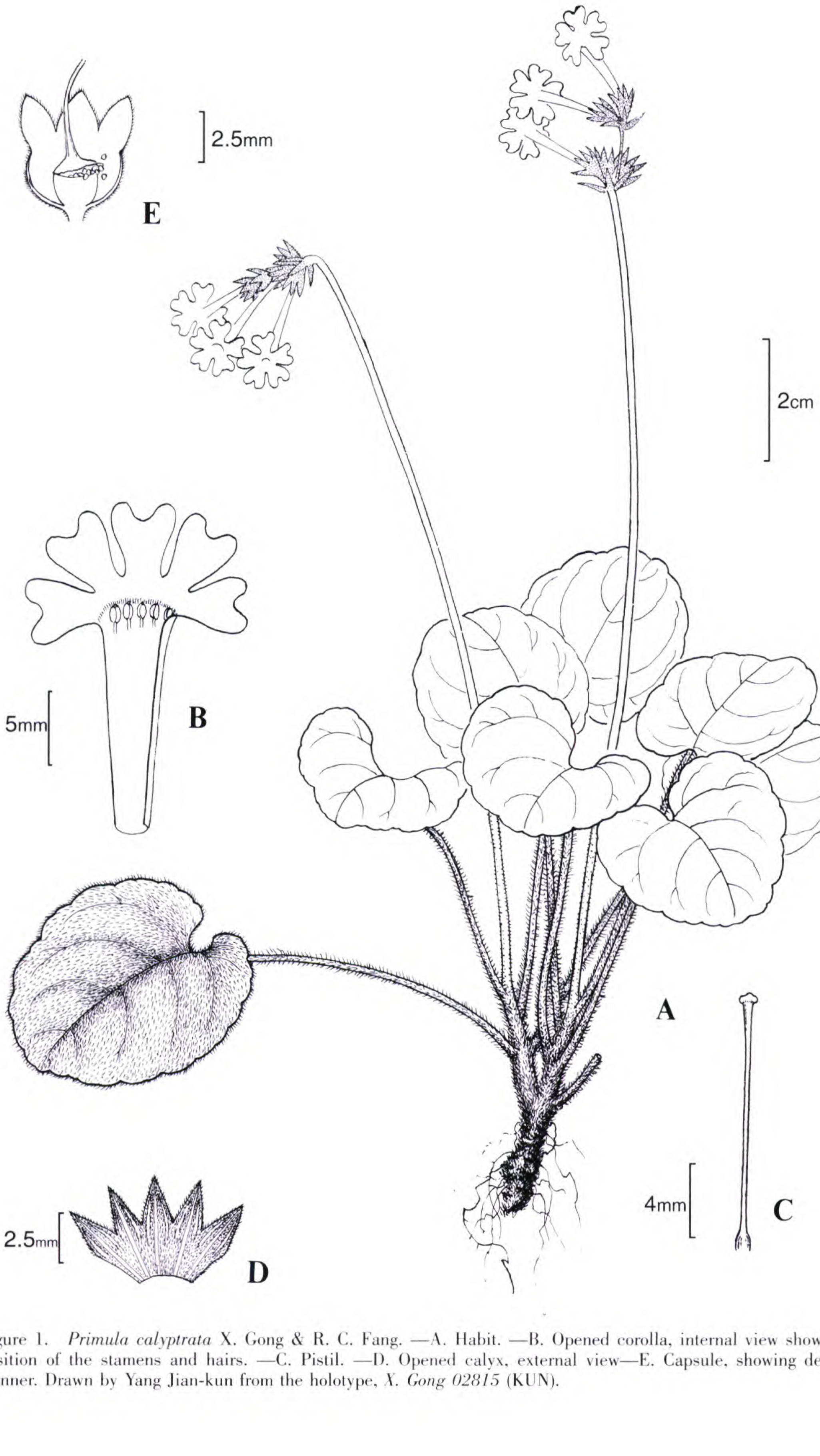

Figure 1. *Primula calyptrata* X. Gong & R. C. Fang. —A. Habit. —B. Opened corolla, internal view showing the position of the stamens and hairs. —C. Pistil. —D. Opened calyx, external view—E. Capsule, showing dehiscent manner. Drawn by Yang Jian-kun from the holotype, *X. Gong 02815* (KUN).

tube 1.7 cm long with a hairy annulus inside, limb 1.5–1.8 cm diam., lobes oblong-obovate, deeply emarginate; homostylous, stamens inserted in throat, anthers below annulus; style ca. 1.7 cm, subequal to corolla tube. Capsule enclosed in calyx tube, dehiscing by means of a calyptra.

Distribution. Known only from the type and paratype specimens collected from both Xiajinchang and Zhongzai forests of Malipo County of southeastern Yunnan, China.

Habitat and phenology. Understory species in an evergreen broad-leaf forest composed of members of the Magnoliaceae, Fagaceae, and Lauraceae, growing on limestone with moss; alt. 1700–1870 m; flowering March–April, fruiting in August.

Primula calyptrata is distinguished from the other species of *Primula* sect. *Carolinella* by having short stems and a leaf blade that is purple on the abaxial surface. This species is closely related to *Primula intanoensis* T. Yamazaki collected from Thailand, but can be distinguished by stems 2–2.5 cm long, leaves alternate, corollas purple, tubes 1.7 cm long, limbs 1.5–1.8 cm in diameter, and pedicels 2–4 mm long. *Primula intanoensis* is stemless, with leaves in a rosette, corollas white, tubes a little longer than to half again as long as the calyxes, limbs 0.8 cm in diameter, and pedicels 5–7 mm long.

Paratype. CHINA. **SE Yunnan:** Malipo County, Zhongzai, 1700 m, 23 Mar. 2002, *Yumin Shui et al. 20336* (KUN).

With the inclusion of the species described here, 11 species are known in *Primula* sect. *Carolinella.*

KEY TO THE SPECIES OF *PRIMULA* SECTION *CAROLINELLA*

1a. Inflorescences umbellate, umbels 1 or 2 superimposed, 2- to 6(9)-flowered; leaf blade pubescent.
  2a. Leaf blade suborbicular or ovate-elliptic, base distinctly cordate, both surfaces markedly pubescent; flowers homostylous.
    3a. Stem 2–2.5 cm long, leaves alternate; corolla purple, tube 1.7 cm long, 2–3 times as long as calyx, limb 1.5–1.8 cm diam.; China . . . . . *P. calyptrata* X. Gong & R. C. Fang
    3b. Stem absent; leaves a rosette; corolla white, tube a little longer than to half as long again as the calyx, limb ca. 0.8 cm diam.; Thailand . . . . . *P. intanoensis* T. Yamazaki
  2b. Leaf blade oblong, elliptic, broadly ovate or broadly elliptic, base broadly cuneate or cordate, both surfaces pubescent or adaxially glabrous; flowers heterostylous.
    4a. Pedicel and calyx glabrous; leaves densely pilose on both surfaces; China . . . . . *P. levicalyx* C. M. Hu & Z. R. Xu
    4b. Pedicel and calyx fulvous pilose; leaves pubescent on margin and abaxial surface.
      5a. Leaf blade subcordate or rounded at base; calyx 4.5–7.5 mm, parted to middle; China . . . . . *P. wangii* F. H. Chen & C. M. Hu
      5b. Leaf blade cuneate or rounded at base.
        6a. Calyx 3–4 mm, parted to 2/3; China . . . . . *P. kweichouensis* W. W. Smith
        6b. Calyx 6–7 mm, parted to 1/3; China . . . . . *P. kwangtungensis* W. W. Smith
1b. Inflorescences abbreviated or almost umbellate, (6)12- to 28-flowered; leaf blade glabrous or glabrescent; flowers heterostylous.
  7a. Leaf blade acute or acuminate at apex.
    8a. Leaf blade cuneate or rounded at base; calyx ca. 3 mm, inconspicuously 5-veined; China, Vietnam . . . . . *P. henryi* (Hemsley) Pax
    8b. Leaf blade cordate at base; calyx 7–10 mm, prominently 10-veined; China, Vietnam . . *P. chapaensis* Gagnepain
  7b. Leaf blade obtuse or rounded at apex.
    9a. Leaf blade cordate at base.
      10a. Leaf blade elliptic-ovate to broadly ovate, 4.5–6 × 3.5–5.5 cm; petiole 2–5 cm long; Vietnam . . . . . *P. cardioeides* W. W. Smith & H. R. Fletcher
      10b. Leaf blade oblong to suborbicular or ovate-rounded, 7–18 × 5–15 cm; petiole 7–26 cm long; China . . *P. partschiana* Pax
    9b. Leaf blade broadly cuneate to subrounded at base; China . . . . . *P. rugosa* N. P. Balakrishnan

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Two New Species of *Primula* (Primulaceae) from China

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ABSTRACT. Two new species of *Primula* from western China are described, illustrated, and compared with putatively related species. Both new species belong to section *Petiolares* subsect. *Davidii* (Balfour f.) Craib, which is characterized by the capsule crumbling irregularly at maturity, the basal buds always having a covering of paleaceous scales, and the leaves being more or less coriaceous, persisting into the following spring, with veins often prominently raised and alveolate abaxially and impressed adaxially. In this subsection there are about 18 species all distributed in Sichuan or Yunnan, with only one species extending to Guizhou, Hubei, Hunan, and Jiangxi.

Key words: China, *Primula*, Primulaceae.

Since the publication of the Primulaceae treatment in the *Flora Reipublicae Popularis Sinicae* (Hu, 1990), the authors carried out a project of introducing wild species of *Primula* for cultivation in the West China Subalpine Botanical Garden in Dujiangyan City in Sichuan Province. In the process we rediscovered *P. davidii* Franchet and *P. filchnerae* Knuth, both of which were previously known only from the type material collected nearly a century ago. In addition, we discovered two new species belonging to section *Petiolares* subsect. *Davidii*, characterized by the capsule crumbling irregularly at maturity, the basal buds always having a covering of paleaceous scales, and the leaves being more or less coriaceous, persisting into the following spring, with veins often prominently raised and alveolate abaxially and impressed adaxially. In this subsection there are about 18 species all distributed in Sichuan or Yunnan, with only one species extending to Guizhou, Hubei, Hunan, and Jiangxi. The new species are described here.

Primula bergenioides C. M. Hu & Y. Y. Geng, sp. nov. TYPE: China. Sichuan: Emei Shan, Jing Shui, alt. 1105 m, 17 Mar. 1994, *Y. Y. Geng 94–003* (holotype, IBSC). Figure 1.

Species affinis *P. hylobiae* et *P. klaverianae*, a quibus foliis scapisque glabrissimis, calyce tantum ad tertiam partem in lobos ovatos fisso differt; ab altera etiam floribus heterogeneis differt.

Perennial herbs, efarinose, with a short comparatively stout rhizome, basally with brown paleaceous bud-scales at flowering time. Leaves forming a spreading rosette, to 30 cm diam.; leaf blade oblong-elliptic to elliptic-obovate, 12–20 × 6–9 cm, apex rounded, tapering from the middle into a very short or almost obsolete winged petiole, irregularly crenate-dentate, papery when dry, ± bullate on the margin and covered with minute glandular hairs when just unfolded from the resting buds, soon glabrate, smooth and quite glabrous on both surfaces when mature; lateral veins 11 to 13 pairs, plane adaxially, raised abaxially, subparallel, angled to midrib ca. 65º, secondary veins obscure on both surfaces. Scapes 13–20 cm, 1 to 2 per plant, glabrous, carrying a terminal umbel of 5 to 11 flowers; bracts lanceolate, 5–8 mm long, brown, paleaceous, glabrous; pedicels 1–1.5 cm, elongated to 2.5 cm in fruit, sparsely glandular-puberulent. Flowers heteromorphic; calyx narrowly campanulate, 10–12 mm long, glandular-puberulent, 5-veined, split to a third of its length; lobes ovate, ca. 3.5 mm wide, apex acute; corolla funnel-shaped, lavender-blue, exannulate. Thrum flower: corolla tube ca. 13 mm long, cylindrical, ampliate above insertion of stamens; limb 1.8–2.5 cm across; lobes obovate, 9 × 8 mm, apex emarginate; stamens inserted at apex of corolla tube; filaments ca. 1.5 mm; anthers linear, ca. 2 mm long; style 5–6 mm long; stigma capitate. Capsule subglobose, included in calyx tube.

Distribution and habitat. Known only from the type locality, growing in fissures on dripping wet sandstone cliffs.

Primula bergenioides is most closely related to *P. hylobia* W. W. Smith and *P. klaveriana* Forrest. From both it can be easily distinguished by its glabrous leaves and scapes and by its calyx splitting

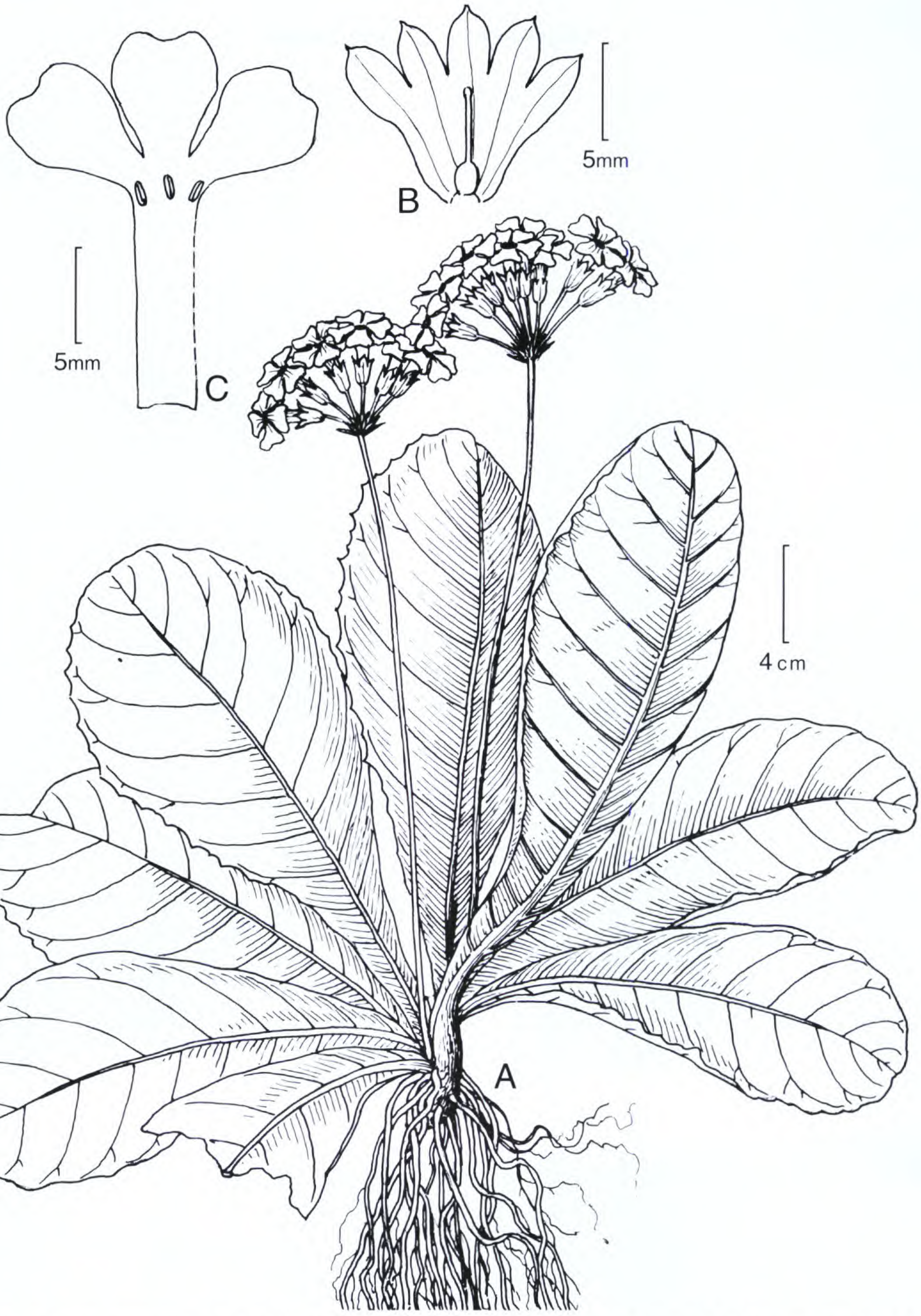

Figure 1. *Primula bergenioides* C. M. Hu & Y. Y. Geng. —A. Habit. —B. Calyx opened up to show pistil. —C. Short-styled flower: portion of opened corolla showing stamens. (Drawn from the holotype.)

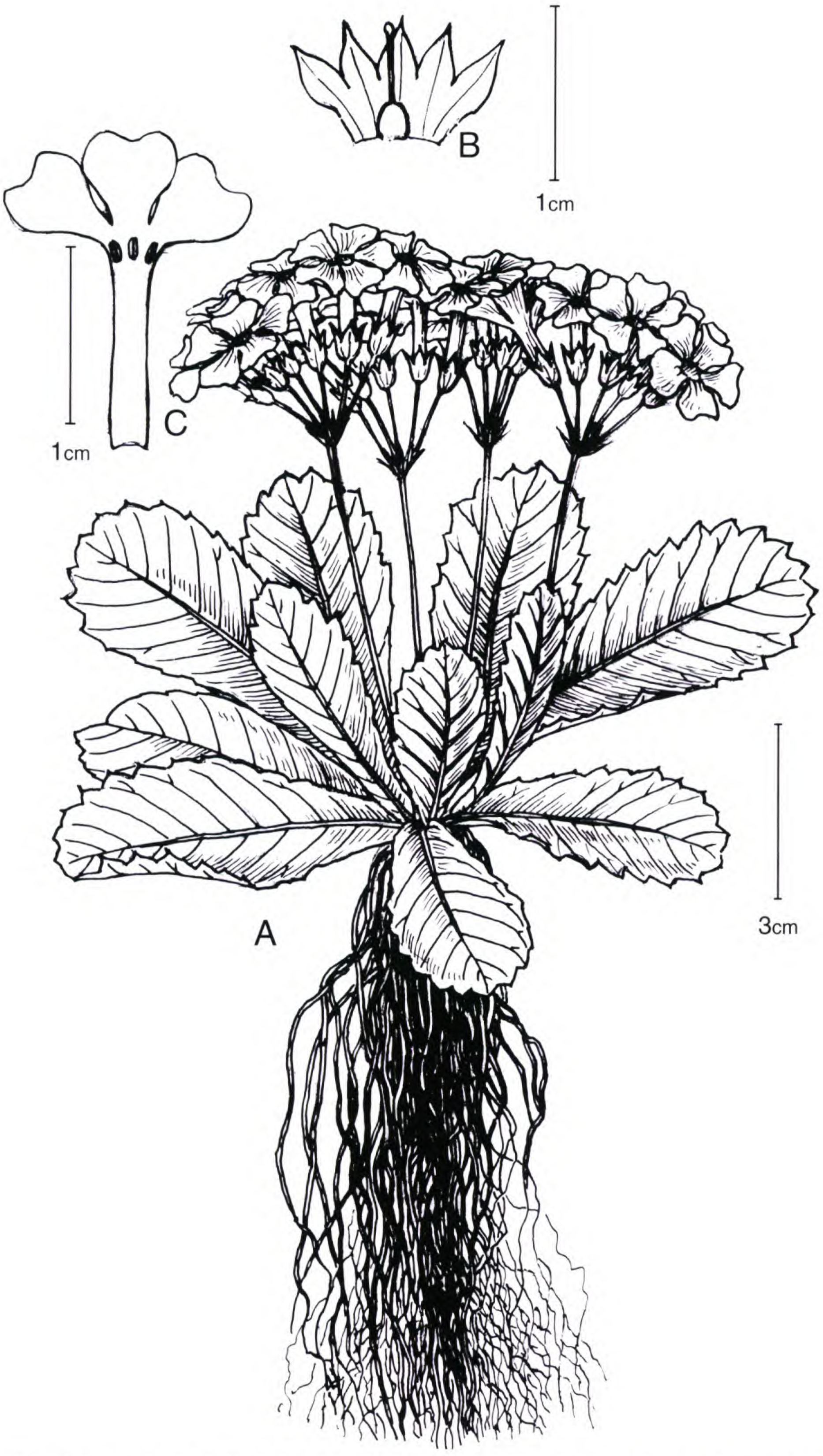

Figure 2. *Primula tenuituba* C. M. Hu & Y. Y. Geng. —A. Habit. —B. Calyx opened up to show pistil. —C. Short-styled flower: portion of opened corolla showing stamens. (Drawn from the holotype.)

only to a third of its length (not to the middle as in the above-mentioned species). Moreover, it stands apart from *P. klaveriana* by its heterogeneous flower.

The specific epithet refers to the comparatively large and dark green leaves, which look somewhat like those of *Bergenia.*

Paratype. CHINA. **Sichuan:** Emei Shan, Jing Shui, 7 May 1990, *C. M. Hu 9067* (IBSC).

Primula tenuituba C. M. Hu & Y. Y. Geng, sp. nov. TYPE: China. Sichuan: Ying Jing Xian, Hua Tan Xiang, Li Jia Yan, alt. 800 m, 14 May 1992, *Y. Y. Geng, Z. L. Zhao et al. 92001* (holotype, IBSC). Figure 2.

Species valde affinis *P. epilosae* Craib, sed floribus minoribus, tubis corollarum tenuioribus, foliis scapis inflorescentiisque glabris, rete venularum invisibili differt.

Perennial herbs with a comparatively stout rhizome from which arise numerous fibrous roots and clothed at base by withered old leaves. Leaves forming a rosette to 15 cm diam.; leaf blade 5–8 × 1.5–3 cm at flowering time, 7–11 × 2.5–3.5 cm at fruiting, oblong-obovate to oblanceolate, tapering from a rounded apex into a very short or almost obsolete winged petiole, irregularly crenate-dentate at margin, thickly papery, adaxial surface scurfy-glandular at flowering, glabrous when mature, ± white farinose on abaxial surface; lateral veins 8 to 11 pairs, prominent on abaxial surface, angled to the midrib ca. 60º, ending in teeth, secondary veins very obscure or invisible. Scapes 4.5–6 cm long, 1 to 4 per plant, glabrous, carrying a terminal umbel of 3 to 7 flowers; bracts 3–4 mm long, acuminate from the broad base, brown, paleaceous; pedicels 1.2–1.5 mm, lengthening to 2 cm in fruit, glabrous. Flowers heteromorphic; calyx campanulate, ca. 7 mm long, 5-veined, glabrous, split almost to middle; lobes ovate, acuminate; corolla violet-blue. Thrum flower: corolla tube slender, ca. 12 mm long, ampliate above insertion of stamens, limb ca. 1.8 cm diam.; lobes obovate, ca. 7 mm long, deeply emarginate; stamens inserted near apex of corolla tube; filaments very short; anthers ca. 1.5 mm long; ovary glabrous; style ca. 5 mm long. Capsule globose, slightly shorter than the persistent calyx.

Distribution and habitat. Known only from the type locality in Sichuan, growing on exposed cliffs near a waterfall; alt. ca. 800 m.

Primula tenuituba is most closely related to *P. epilosa* Craib, from which it differs by the smaller flowers with a very slender corolla tube and by the leaves being glabrous and not strongly reticulate with a network of veinlets on the abaxial surface.

The specific epithet refers to the slender corolla tube of the plant.

Paratype. CHINA. **Sichuan:** Ying Jing Xian, Hua Tan Xiang, Li Jia Yan, alt. 800 m, 17 May 1990, *Y. Y. Geng, Z. L. Zhao et al. 90068* (IBSC).

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A New Subspecies of *Hippophae* (Elaeagnaceae) from China

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ABSTRACT. In this paper, a new subspecies of *Hippophae* (Elaeagnaceae), *H. rhamnoides* subsp. *wolongensis* Y. S. Lian, K. Sun & X. L. Chen, from China is described and illustrated. According to an analysis of the distribution and main characters, it is allied to *H. rhamnoides* subsp. *sinensis* Rousi but is distinct in having rosulately arranged flower buds, larger, alternate leaves with usually more or less sinuous margins, longer petioles, and longer peduncles. *Hippophae rhamnoides* subsp. *wolongensis* is rare and occurs only in Wenchuan and Mao Counties of Sichuan Province, at 1660–1920 m. A key including five subspecies of *Hippophae rhamnoides* in China is provided.

Key words: China, Elaeagnaceae, *Hippophae*, Sichuan.

Hippophae L. is a small genus of Elaeagnaceae in which 6 species and 10 subspecies have been recognized (Lian, 2000). These species are distributed widely but sparsely in Asia and Europe. Most of them, however, are restricted to the Qinghai–Tibetan plateau and adjacent areas, and only the species *Hippophae rhamnoides* L. occurs in both Asia and Europe. All of the species and six of the subspecies are found in China (Lian, 1988, 2000; Lian & Chen, 1996).

The authors, investigating populations of *Hippophae rhamnoides* in Gansu, Qinghai, Sichuan, Yunnan, and Xizang (Tibet) Provinces in 2000, found several unusual populations from Wenchuan and Mao Counties in Sichuan. These populations were found to occur together with populations of *H. rhamnoides* subsp. *sinensis* in the above locations but at different elevations. After critical study based on ample specimens gathered from the special populations, the specimens were found to represent a new subspecies of *H. rhamnoides*. Following are the description and discussion of the new subspecies. A key including five subspecies of *Hippophae rhamnoides* in China is also provided.

Hippophae rhamnoides L., Sp. Pl. 1023. 1753.

Hippophae rhamnoides, which comprises nine subspecies, is now widely distributed in temperate Asia and Europe. Subspecies *rhamnoides*, subspecies *fluviatilis* V. Soest, and subspecies *carpatica* Rousi are represented in Europe, and subspecies *caucasia* Rousi, subspecies *turkestanica* Rousi, subspecies *mongolica* Rousi, subspecies *sinensis* Rousi, subspecies *yunnanensis* Rousi, and the new subspecies *wolongensis* are represented in Asia. Subspecies *sinensis*, subspecies *yunnanensis*, and subspecies *wolongensis* are restricted to China.

Hippophae rhamnoides subsp. **wolongensis** Y. S. Lian, K. Sun & X. L. Chen, subsp. nov. TYPE: China. Sichuan: Wenchuan, Wolong, 1920 m, in the Sea Buckthorn shrub community on mountain slopes or river banks (fruit), 25 Sep. 2000, *Y. S. Lian, X. L. Chen & K. Sun w11* (holotype [pistillate], NWTC). Figure 1.

Subspecies haec margine foliorum plus minusve sinuata, petiolis longioribus 2–4 mm longis, pedunculis 3–5 mm longis, gemmis florum masculorum 5–11, femineorum 5–7, rosulatim insertis, fructibus et seminibus conspicue minoribus differt.

Shrubs or small trees, deciduous, 3–5 m high; usually much branched, young branches red-brown, striate, and covered with scales on the surface; old branches dark brown, constricted into a spine tip. Leaves usually alternate, or sometimes subopposite on the upper branchlets, elliptic-lanceolate, 50–85 × 6–16 mm, acute or acuminate at the apex, base cuneate or broadly cuneate, blade margins usually ± sinuous, upper blade surface green, covered by scales, often early deciduous, lower blade surface covered by dense, gray scales, sometimes mixed with a few red-brown scales; costae impressed in a conspicuous groove on the upper surface; petioles 2–4 mm long. Staminate flower buds 5–11, pistillate 5–7, rosulately arranged, with red-brown scales on the outside. Fruits yellow, subglobose, 4–5.5(6) × (4.5)5–6(7) mm, with sparse red-brown scales; peduncle 3–5 mm long. Seeds obovate to oblong, mucronate at the apex, 3–4 × ca. 1.5 mm, seed coat easily separated from endocarp. Flowers were only collected in bud; fruiting in September to October. This subspecies is distributed in the shrub community on mountain slopes at 1660–1920 m.

Figure 1. *Hippophae rhamnoides* subsp. *wolongensis* Y. S. Lian, K. Sun & X. L. Chen. —A. Habit of pistillate plant with fruits. —B. Pistillate flower bud. —C. Seed. —D. Habit of staminate plant with flower buds. —E. Staminate flower bud. —F. Basal leaf blade of staminate plant showing petiole and scales. —G. Close-up of scale trichomes. (A, B, C, F & G based on *Y. S. Lian, X. L. Chen & K. Sun w11* (pistillate, NWTC); D & E based on *Y. S. Lian, X. L. Chen & K. Sun w21* (staminate, NWTC); drawn by Jianlu Bai.)

This subspecies has an affinity with *Hippophae rhamnoides* subsp. *sinensis* in several characters, including the endocarp easily separating from the seed coat, the length of the fruit usually less than or equal to the width, and the leaves relatively larger. They differ in that the flower buds of subspecies *wolongensis* are rosulately arranged while those of subspecies *sinensis* are 4-angled, tower-shaped in staminate form and cruciform in pistillate form; larger, alternate leaves with usually more or less sinuous margins in subspecies *wolongensis* vs. smaller, opposite or subopposite leaves with entire margins in subspecies *sinensis*; and longer petioles (2–4 mm long vs. 1.5–3 mm) and peduncles (3–5 mm vs. 1–2.5 mm) in subsp. *wolongensis* than in subsp. *sinensis*. Subspecies *wolongensis* is confined to Wenchuan and Mao Counties of Sichuan Province, but subspecies *sinensis* is widely distributed in southwestern, northwestern, and northern China. *Hippophae rhamnoides* subsp. *wolongensis* occurs together with subspecies *sinensis* in Wenchuan and Mao Counties; however, subspecies *wolongensis* occurs at 1660–1920 m while subspecies *sinensis* is found at over 2100 m.

Paratype. CHINA. **Sichuan:** Mao County, Changhai, 1660 m, in the Sea Buckthorn shrub community on mountain slopes (flowers in buds), 26 Sep. 2000, *Y. S. Lian, X. L. Chen & K. Sun w21* (staminate, NWTC).

Key to Five Subspecies of *Hippophae rhamnoides* in China

1a. Flower buds rosulately arranged or alternatively opposite or subopposite; length of fruits usually less than or equal to breadth.
  2a. Leaves elliptic-lanceolate, blade margins usually more or less sinuous; flower buds rosulately arranged; peduncles 3–5 mm long . . . . . *H. rhamnoides* subsp. *wolongensis* Y. S. Lian, K. Sun & X. L. Chen
  2b. Leaves lanceolate or narrowly lanceolate, blade margins entire; flower buds opposite or subopposite; peduncles 1–2.5 mm long.
    3a. Branchlets stiff; most leaves opposite or subopposite, lower blade surface covered with white scales or rarely mixed with rusty-red scales, petioles 1.5–3 mm long; staminate flower buds manifestly 4-angled, tower-shaped, pistillate flower buds cruciform; most fruits tangerine, endocarp separating easily from the seed coat . . . . . *H. rhamnoides* subsp. *sinensis* Rousi
    3b. Branchlets soft; most leaves alternate, lower blade surface covered with rusty-red scales, petioles 1–1.3(2) mm long; staminate flower buds inconspicuous, 4-angled, tower-shaped, pistillate flower buds near cruciform or bifid ovate; most fruits yellow, endocarp sometimes hard to separate from the seed coat . . . . . *H. rhamnoides* subsp. *yunnanensis* Rousi
1b. Flower buds spirally arranged; the length of fruits usually longer than breadth.
  4a. Branches silvery, usually with more-branched thorns; leaf blades 2–4(5) mm wide, upper surface silvery; peduncles 3–4(7) mm long . . . . . *H. rhamnoides* subsp. *turkestanica* Rousi
  4b. Branches brown, with less- and un-branched thorns; leaf blades (3)4–8 mm wide, upper surface often green; peduncles 1–4 mm long . . . . . *H. rhamnoides* subsp. *mongolica* Rousi

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A New Species of *Cymbidium* (Orchidaceae) from Tibet (Xizang), China

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ABSTRACT. *Cymbidium chawalongense* C. L. Long, H. Li & Z. L. Dao (Orchidaceae), collected from southeast Xizang (Tibet), China, is described as new. The new species is similar to *C. floribundum* Lindley in morphology and habitat, but differs in having an erect scape, very widely spread flowers, pale green sepals and petals, and a white, non-mottled lip.

Key words: China, *Cymbidium*, Orchidaceae, Tibet, Yunnan.

There are about 48 species in the genus *Cymbidium* Swartz, distributed in tropical and subtropical regions of Asia and Australia (Chen, 1999). About 29 species are distributed in China, of which 28 are found in Yunnan Province (Chen, 1999). This may suggest that the Chinese center of species diversity of the genus is Yunnan. Because of the particular significance of *Cymbidium* to horticulture and traditional culture in China and its neighboring countries, the discovery of a new member of the genus will stimulate much interest among horticulturists and orchid enthusiasts (Yang et al., 1993). The new *Cymbidium* species was collected during a recent biodiversity expedition and appears different from all other species in the genus.

The distribution of this species includes the type locality in southeast Tibet and extends into northwest Yunnan. This area lies at the conjunction of two of the world's most biologically rich and most threatened environments, i.e., the Indo-Burma and South-Central China hotspots of biodiversity (Myers et al., 2000). Some 5000 higher plant species have been recorded from the Gaoligong Mountains between the great Salween and Irrawaddy Rivers (Li et al., 2000) in this region. Among them, 266 species are orchids. At least 10 orchid species, including *Cymbidium gongshanense* H. Li & K. M. Feng, *Calanthe dulongense* H. Li, *Paphiopedilum markianum* Fowlie, and *Coelogyne tarongense* Handel-Mazzetti, are considered endemic to this region (Li et al., 2000). This new orchid species is also endemic to the Gaoligong Mountains.

Cymbidium chawalongense C. L. Long, H. Li & Z. L. Dao, sp. nov. TYPE: China. Xizang [Tibet]: Chayu Xian, Chawalong, 2300 m, in coniferous forest, flowers pale greenish, 14 May 2001, *Gaoligongshan Expedition 13727* (holotype, KUN). Figure 1.

Species nova *Cymbidio floribundo* affinis, sed scape erecto 22 cm longo, floribus patulis, sepalis et petalis chloroticis, labello albo non maculato differt.

Plants terrestrial, to 43 cm tall, with a short rhizome. Pseudobulbs congested, cylindric, slightly flattened, 1.5 cm long and thick, enclosed in cataphylls and leaf bases. Cataphylls 3 or 4, widely ovate and lanceolate, 2–5.5 × 2–2.5 cm at base, acuminate at apex. Leaves usually 5 per pseudobulb, dark green, thinly coriaceous, slightly arching, 27–43 cm long (including sheath), 1.4 cm broad, apex acute and unequally retuse, base slightly narrowed, plicate, articulate, midrib depressed above and prominent below; sheath green, 2.5–5 cm long. Scape lateral from pseudobulb base, erect, robust, to 22 cm tall; peduncle pale green, 9 cm long, 3–4 mm diam., base enclosed in 5 or 6 cataphylls; raceme green, 10 cm long, loosely 17-flowered; pedicel and ovary green-tinged, cylindric, 3.3 cm long, shortened upward, the terminal one 2.5 cm long; bracts small, green, deltoid, 2–2.3 cm long; flowers widely spread, to 4 cm across; sepals and petals pale green, lip white, not mottled; middle sepal oblong, 2 cm long, 3 mm broad, apex acute, margins slightly recurved, 3-nerved; lateral sepals similar to middle but falcately curved, 2.2 × 0.4 cm, 5-nerved; petals elliptic, 1.8 × 0.7 cm, margins slightly recurved, 5-nerved; lip sub-oblong, to 1.8 cm, 3-lobed, lateral lobes erect, to ca. 1.5 mm; mid-lobe subovate, 1 × 0.5 cm, smooth, recurved; disc with 2 yellow lamellae; column semicylindric, arcuate, erect, to 1.5 cm long, to 4–5 mm broad at upper part. Anther yellow, cucullate; pollinia 2, waxy, ovoid, ca. 1 mm diam., stipe short, viscid disc oblong; ovary ca. 2.5 mm diam., stigma transversely oblong, deeply concave. Flowering in May.

Figure 1. *Cymbidium chawalongense* C. L. Long, H. Li & Z. L. Dao. —A. Flowering plant. —B. Middle sepal, petal, lateral sepal, and lip. —C. Pollinia, stipe, and viscid disc. Drawn by Yitao Liu, from the holotype collection.

Distribution. Endemic to China from Chayu in southeastern Xizang (Tibet) and northwestern Yunnan. Populations were occasionally seen in Gongshan Xian and Weixi Xian of northwestern Yunnan, but specimens were not collected from these locations to protect the natural populations. Two living collections are being kept in the Kunming Botanical Garden. We saw the living plants in forests three times and in the local markets two times. The new species was found in coniferous forest, evergreen forest, and secondary successions, at altitudes from 1600 to 2300 m. Forests there mainly consist of *Pinus yunnanensis* Franchet, *Betula* sp., *Acer* spp., *Cinnamomum* spp., *Litsea* spp., *Lindera* spp., and *Lithocarpus* spp. Understory plants are represented by *Excoecaria acerifolia* F. Didrichsen, *Campylotropis* spp., and *Desmodium* spp.

Notes. Both *Cymbidium chawalongense* and *C. floribundum* are members of subgenus *Cymbidium*. They are very similar in morphology by having smaller flowers, lip and column separated, and two pollinia. Their natural habitat is also similar. They can, however, be easily distinguished because of the very opened flowers, pale green sepals and petals, and the white, non-mottled lip of the new species.

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A New Species of *Posoqueria* (Rubiaceae) from Bahia, Brazil

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ABSTRACT. *Posoqueria bahiensis* from southern Bahia, Brazil, is described as a new species. It differs most notably from all the other species of the genus in being totally glabrous except at the corolla fauce and anthers and in the densely multiflowered inflorescence with ca. 40 flowers.

Key words: Brazil, *Posoqueria*, Rubiaceae.

During the revision of the genus *Posoqueria* Aublet, it was evident that specimens from southern Bahia, Brazil, represent a new species. *Posoqueria bahiensis* is herein described and illustrated.

Posoqueria is a Neotropical genus belonging to the subfamily Ixoroideae, tribe Gardenieae, subtribe Gardeniinae (Robbrecht, 1988, 1993). The Brazilian species were mainly treated by Schumann (1889). The whole genus was treated by Macias (1988), who recognized 14 species.

Posoqueria bahiensis L. Macias & L. S. Kinoshita, sp. nov. TYPE: Brazil. Bahia: Maraú, restinga, 6 Oct. 1965 (fl), *R. P. Belém 1877* (holotype, UB; isotypes, CEPEC, IAN, NY, VEN). Figure 1.

Posoqueriae latifoliae (Rudge) Roemer & Schultes foliorum textura tantum similis sed planta omnis glabra (fauce et antheris pilosis), inflorescentiis densis ca. 40 floribus differt.

Treelet up to 5 m high, entirely glabrous. Leaf blades 13.8–32 × 6.8–23 cm, ovate, oblong to elliptic, acute or acuminate at apex, entire or rarely slightly undulate and slightly revolute at margin, rounded at base, strongly coriaceous, dark green and shining above, paler and slightly opaque beneath, secondary nerves in 5 to 8 pairs, alternate or subopposite; petioles 1.5–3 cm long; stipules interpetiolar, 0.8–1.5 × 0.5–0.8 cm, deltoid, acute at apex. Inflorescence almost spherical, ca. 30 cm diam.; 3-times branched corymbiform cymes, peduncle 6–8 cm long; bracts linear, 5–8 mm long. Flowers ca. 40, very fragrant, pedicels 0.6–1.3 cm long; bracteoles linear, ca. 2 mm long. Hypanthium ca. 2 mm long, obovoid, glabrous; calyx limb-tube ca. 2 mm long with a few colleters inside at the base; calyx lobes triangular, ca. 1 mm long, ciliate; corolla hypocrateriform, 9–14 cm long, tube pale green, 6–12 cm long, 1–2 mm wide at base, internal proximal region minutely papillate, distal region with conspicuous sparsely distributed round papillae; fauce glabrous to sparsely villous; lobes white, 1.5–1.8 × 0.3–0.5 cm, oblong, rounded at apex. Filaments 1.8–2 mm long; anthers ca. 0.5 cm long, linear-lanceolate, sparsely puberulous. Hypanthium glabrous; style 4–4.9 cm long, stigma ca. 2 mm long. Fruits ovoid, coriaceous, 3.5–5.2 × 2.8–3.8 cm, apricot colored (*in vivo*), seeds blackish, ca. 1.1 × 0.7 cm.

Distribution. In southern Bahia, Brazil, in disturbed rain forest.

Phenology. Flowering in October; fruit collected in January to September.

Posoqueria bahiensis differs from other species of the genus in the glabrescent corolla fauce and anthers, the densely flowered inflorescence (ca. 40 flowers), and the strongly coriaceous leaves. Table 1 shows a character comparison among four species of *Posoqueria* morphologically related to *P. bahiensis*. *Posoqueria bahiensis* is similar to *P. latifolia* (Rudge) Roemer & Schultes in the texture of the leaves, but differs by the dense inflorescence with ca. 40 flowers. It is also similar to *P. williamsii* Steyermark, but differs in leaf indumentum and texture and number of flowers. The new species also resembles *P. maxima* Standley, but this has lax inflorescences with only 10 to 20 flowers. *Posoqueria bahiensis* is known only from southern Bahia, Brazil.

Paratypes. BRAZIL. **Bahia:** Parque Nacional de Monte Pascoal, on NW side of Monte Pascoal at low al-

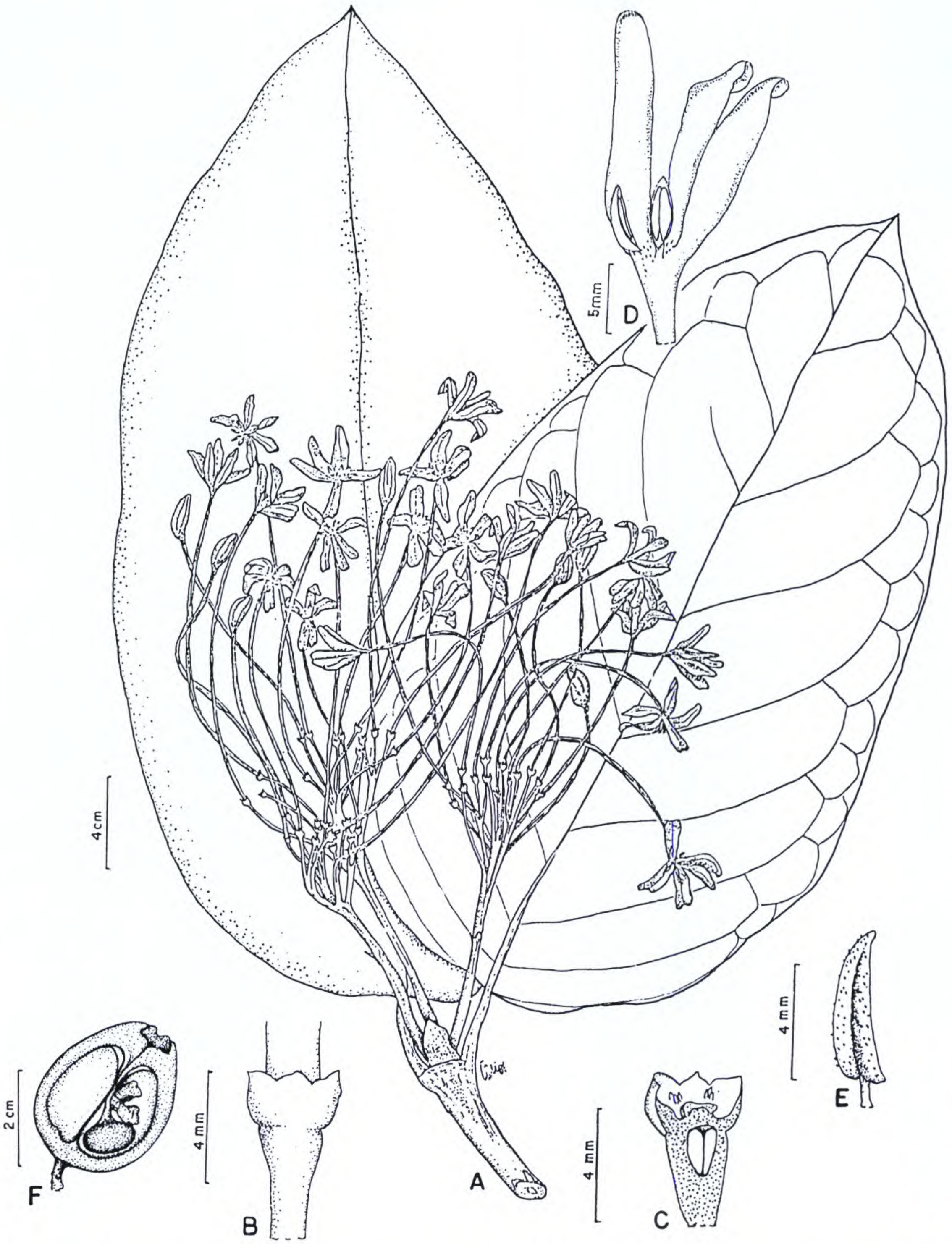

Figure 1. *Posoqueria bahiensis* L. Macias & L. S. Kinoshita. —A. Flowering branch. —B. Hypanthium, external view. —C. Ovary, longitudinal section showing the colleters alternating with the lobes. —D. Corolla fauce and anthers. —E. Stamen, sparsely puberulous anthers. —F. Longitudinal section of the fruit. (A–E from *Belém 1877*, UB; F from *Harley et al. 17898*, CEPEC.)

Table 1. Comparison of some morphological characters among five *Posoqueria* species.

Species	Leaf size (cm)	Leaf shape	Leaf indumentum	Leaf texture	Inflorescence	Flower number	Distribution
P. acutifolia	5.5–8.5 × 1.4–4.7	Elliptical, lanceolate to oblong-lanceolate	Glabrous	Chartaceous to subchartaceous	Lax	10–20	Brazil: Minas Gerais, Rio de Janeiro, São Paulo
P. bahiensis	13.8–32 × 6.8–23	Ovate, oblong to elliptical	Glabrous	Strongly coriaceous	Dense	Ca. 40	Brazil: Bahia
P. latifolia	10–30 × 5–15	Elliptical, ovate-lanceolate to wide ovate	Glabrous to puberulous on abaxial side	Chartaceous to coriaceous	Sublax	6–30	Southern Mexico to southern Brazil
P. maxima	25–30 × 16–24	Ovate, widely ovate to suborbicular	Glabrous	Chartaceous to subcoriaceous	Lax	10–20	Colombia, Ecuador, Peru
P. williamsii	25–39.5 × 13.5–17	Lanceolate-ovate to elliptical-ovate	Glabrous adaxially, villous abaxially	Subcoriaceous	Dense	20–30	Costa Rica, Panama, Venezuela

titude, between IBDF field hut and gates of the Parque Nacional, 39°25′W, 16°53′S, 12 Jan. 1977 (fr), *R. M. Harley et al. 17898* (CEPEC); Uruçuca, District of Serra Grande, 7.3 km along road Serra Grande/Itacaré, Fazenda Lagoa do Conjunto Fazenda Santa Cruz, 39°01′W, 14°25′S, 4 Fev. 1991 (fr), *J. C. Jardim et al. 607* (CEPEC, MO), 11–21 Set. 1991, (fr), *A. M. Carvalho et al. 3521* (CEPEC), 26 Oct. 1993 (fl), *W. W. Thomas et al. 10166* (CEPEC).

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A New Species of *Tillandsia* (Bromeliaceae) from the Mexican Yucatán Peninsula

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ABSTRACT. A new species of *Tillandsia* is proposed. It is similar to *Tillandsia brachycaulos* Schlechtendal and *Tillandsia balbisiana* Schultes f., two sympatric species. The new species is most similar to *T. brachycaulos* in flower and bract color, but the elongated inflorescences resemble those of *T. balbisiana*, although the branches are much shorter.

Key words: Bromeliaceae, Mexico, *Tillandsia*, Yucatán.

The Bromeliaceae of the Yucatán Peninsula have recently been reviewed by Ramírez and Carnevali (1999). Later, the same authors proposed the additional species, *T. jaguactalensis* I. Ramírez, Carnevali & Chi (Ramírez et al., 2000), bringing to 20 species the number of taxa in the genus that were thus known to occur in the Mexican portions of the Yucatán Peninsula. This makes *Tillandsia* the largest genus of epiphytes in the area, followed by the orchid genera *Epidendrum* L. (12 species) and *Trichocentrum* Poeppig & Endlicher s.l. (8 species) (Carnevali et al., 2001, and unpublished data). Further exploration and study of the area's Bromeliaceae will certainly continue to yield taxonomic novelties.

The novelty here presented is noteworthy because it seems intermediate between two sympatric species, *Tillandsia brachycaulos* and *Tillandsia balbisiana*, which are widespread and locally common in most of the Yucatán Peninsula.

Tillandsia maya I. Ramírez & Carnevali, sp. nov. TYPE: Mexico. Yucatán: Municipio Mérida, Parque Nacional de Dzibilchaltún, vegetación de selva baja caducifolia, aprox. 89°35′49″W, 21°5′44″N, ago. 2001 ["planta epífita, flores moradas, 1 ó 2 abiertas simultáneamente, estigma apenas saliendo por encima del tubo de la corola, creciendo con *Tillandsia brachycaulos* Schltdl., *T. balbisiana* Schult. f., *T. elongata* (Kunth.) var. *subimbricata* (Baker) L. B. Sm., *T. paucifolia* Baker"], *I. Ramírez, G. Carnevali, F. Chi-May & U. González 929* (holotype, CICY). Figure 1.

Species haec *T. brachycaulos* affinis, sed plantis majoribus, foliis reflexis paucioribus, inflorescentiis scaposis, ramulis pedunculum adpressis diversa; *T. balbisiana* ramis inflorescentiae brevioribus non-complanatis, floribus fasciculatis recedit.

Medium-sized epiphytic herbs, 28–40 cm tall. Rosettes erect, with 16–20 leaves. Foliar sheaths densely lepidote on both surfaces, membranaceous, green, (4–)5–7 cm long, (2.5–)3–4 cm wide, oblong, attenuate toward the apex; lamina narrowly triangular, attenuate, apex recurved, twisted when dry, green on both surfaces, minutely lepidote, (12–)30–35 cm long, (1.5–)1.8–2(–3) cm wide, somewhat concave. Inflorescence a panicle with short, appressed branches, 27–35 cm long measured from the base of the rosette, erect, cylindric, many-flowered, as long as to much longer than the leaves; peduncle either partially enveloped (1/2 of its length) by the primary bracts or completely exposed; 14–18 cm long measured from the base of the rosette to the base of the fertile portion of the inflorescence; fertile portion of the inflorescence 10–15 cm long, with 7 to 9 polystichously arranged appressed branches; primary bracts from broadly elliptic to ovate-elliptic, 17–28 cm long, free portion of the primary bract 8–12 mm wide, foliaceous, abruptly tapering into a narrowly triangular acuminate lamina, diverging and exposing the apex of the branch, basally red, apically green, minutely lepidote on both surfaces, nerved when dry. Branches appressed to the main axis or slightly diverging, with 3–5 flowers each, 3–3.5 cm long, 0.9–1 cm wide. Floral bract ca. 2 cm long, ca. 0.7 cm wide, narrowly elliptic, acute, densely lepidote inside, green outside, apically red, keeled. Flowers 4–4.5 cm long, erect, 1 or 2 open per branch at any given time, thus inflorescences display several flowers open simultaneously, each one lasting one day; sepals 12–15 mm long, 3–4 mm wide, posterior ones connate for 2/3 of their length, the anterior one connate for 1/3 of its length, white, apically reddish, sparsely lepidote; petals imbricate, making a tube-like corolla, 32–34 mm long, 5–6 mm wide,

Figure 1. *Tillandsia maya* I. Ramírez & Carnevali. —A. Habit with inflorescence, showing also an old inflorescence from the previous rosette. —B. Flower with floral bract and fascicle bracts. —C. Flower with sepals. —D. Floral bract flattened. —E. Sepals flattened. —F. Petal flattened. —G. Stamen with dorsifixed anther. —H. Ovary, style, and stigma with details of the stigmatic region. (Drawn from holotype, *Ramírez et al. 929*, CICY.)

base narrowly oblong, blade elliptic, obtuse, purple, constricted at 14–15 mm from the base, base narrowly oblong; stamens in two series, white, filaments 4 and 7 cm long, pollen bright yellow; anthers 3 mm long, 1 mm wide, versatile, dorsifixed, dark brownish; style 32–35 mm long, stigma conduplicate-spiral, with three white lobes, 2 mm long each, surpassing the anthers in anthesis, white, green–tinged; ovary 5 mm long, 2 mm wide, locules 2.5 mm long, 30 to 33 ovules per locule.

Etymology. The specific epithet honors the Maya, the first people to inhabit the area where the plants of this new taxon were collected.

Tillandsia maya belongs in subgenus *Tillandsia* and seems closely related to *Tillandsia balbisiana.* With this species, *T. maya* shares a similar vegetative habit (pseudobulbose rosette) with curled leaves and an elongated inflorescence. The rosettes of *T. maya,* however, are less conspicuously pseudobulbose and the leaves are comparatively less lepidote, looking greener than in *T. balbisiana.* The inflorescences are proportionally shorter in *T. maya* than in *T. balbisiana.*

The inflorescence of *Tillandsia maya* is similar to that of the recently described *Tillandsia maypatii* I. Ramírez & Carnevali (Ramírez & Carnevali, 1999). Both taxa share a condensed panicle with sessile, appressed branches. *Tillandsia maypatii,* however, features larger (5–5.5 cm long), white flowers, more numerous leaves (30 to 40) in a more open rosette. The inflorescences in *T. maypatii* are also proportionally shorter and denser.

The habitat where this new taxon occurs is a low caducifolious forest, dominated by *Gymnopodium floribundum* Rolfe trees, a member of the Polygonaceae. *Tillandsia maya* grows as an epiphyte at relatively low elevations (0.5–3 m) from the floor and among several other epiphytic species such as *Tillandsia elongata* var. *subimbricata* (Baker) L. B. Smith, *T. recurvata* (L.) L., *T. fasciculata* Swartz, *T. schiedeana* Steudel, *T. paucifolia* Baker, *Aechmea bracteata* (Swartz) Grisebach, and epiphytic orchids such as *Trichocentrum cebolleta* (Jacquin) M. W. Chase & N. H. Williams and *Harrisella porrecta* (Reichenbach f.) Fawcett & Rendle. Despite five years of fieldwork in the park, only two plants of this new taxon have been found, one of them under cultivation at the Jardín Botánico Regional CICY.

Paratype. MEXICO. **Yucatán:** Municipio Mérida, Parque Nacional de Dzibilchaltún, aprox. 89°35′49″W, 21°5′44″N, ago. 2002 ["planta epífita, flores moradas, 1 ó 2 abiertas simultáneamente, estigma apenas saliendo por encima del tubo de la corola, creciendo con *Tillandsia brachycaulos* Schltdl. y *T. balbisiana* Schult. f."], *I. Ramírez & G. Carnevali 956* (MO).

Acknowledgments. The authors thank Francisco Chi-May, Ulises González, and Filogonio May Pat for field assistance and specimen handling. We are indebted to Ginette Farreny for the line drawing of the new taxon. Rossana Marrufo drew the dissected sepals of the new entity.

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New Status and Combinations for Japanese Taxa of *Chionographis* (Melanthiaceae)

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ABSTRACT. *Chionographis japonica* var. *hisauchiana* Okuyama is raised to specific rank as *C. hisauchiana* (Okuyama) N. Tanaka, since it differs markedly from *C. japonica* (Willdenow) Maximowicz var. *japonica* in several characters. *Chionographis japonica* var. *minoensis* H. Hara and *C. japonica* var. *kurohimensis* Ajima & Satomi are transferred to *C. hisauchiana* at subspecific rank as *C. hisauchiana* subsp. *minoensis* (H. Hara) N. Tanaka and *C. hisauchiana* subsp. *kurohimensis* (Ajima & Satomi) N. Tanaka, respectively. A key to the four taxa accepted here is presented.

Key words: *Chionographis*, Japan, Melanthiaceae.

The genus *Chionographis* Maximowicz is often placed in the tribe Heloniadeae, together with *Chamaelirium* Willdenow of eastern North America and a few other genera (Engler, 1888, tribe as Helonieae; Hutchinson, 1934; Tamura, 1998), under Melanthiaceae (Maximowicz, 1867, as Melanthaceae; Tamura, 1998) or Liliaceae (Engler, 1888; Hutchinson, 1934). It is apparently most closely allied to *Chamaelirium*, from which it differs mainly by its zygomorphic flowers (vs. actinomorphic), unequal tepals (vs. equal), fewer ovules (2 vs. 6–12 ovules per locule), polycentric chromosomes (vs. monocentric), and in the sexual attributes (plants usually hermaphrodite or gynodioecious vs. dioecious) (Tanaka & Tanaka, 1977, 1979; Tanaka, 1985).

Chionographis is distributed in Japan, Korea, and southern China (Hara, 1968; Chen, 1980; Tanaka, 1985; Chen & Tamura, 2000). According to Hara (1968), it comprises four species, of which two, *C. japonica* (Figs. 1A, 2A) and *C. koidzumiana* Ohwi, are distributed in Japan (the former also in southern Korea). Only the former species, as traditionally circumscribed, is considered here. Hara (1968) recognized three subspecies under *C. japonica*, i.e., subspecies *japonica*, subspecies *hisauchiana* (Okuyama) H. Hara (Figs. 1B, 2B, under the name *C. hisauchiana* subsp. *hisauchiana*), and subspecies *minoensis* (H. Hara) H. Hara (Fig. 2C, under the name *C. hisauchiana* subsp. *minoensis*). Later, a new variety, *C. japonica* var. *kurohimensis* Ajima & Satomi (Fig. 2D, under the name *C. hisauchiana* subsp. *kurohimensis*), was described by Ajima (1976).

Hara's *Chionographis japonica* subsp. *hisauchiana* (Figs. 1B, 2B) differs markedly from *C. japonica* subsp. *japonica* (Figs. 1A, 2A) in several characters such as floral, vegetative, chromosomal, sexual, and breeding attributes (Tanaka, 1985, and key below). It seems, therefore, more appropriate to treat it at specific rank. Hara's *C. japonica* subsp. *minoensis* (Fig. 2C) and Ajima and Satomi's *C. japonica* var. *kurohimensis* (Fig. 2D) are, respectively, much closer in morphological, chromosomal, sexual, and breeding characters to *C. hisauchiana* than to *C. japonica* (Tanaka, 1985, and key below). *Chionographis japonica* subsp. *minoensis* differs from *C. hisauchiana* mainly in leaf characters and has a disjunct distribution from the latter. It is transferred here to *C. hisauchiana* without any change in rank. *Chionographis japonica* var. *kurohimensis* differs from *C. hisauchiana* subsp. *hisauchiana* and *C. hisauchiana* subsp. *minoensis* in chromosome number and some morphological characters (Tanaka, 1985, and key below) and has a disjunct distribution from the latter subspecies. It is therefore treated here as a third subspecies of *C. hisauchiana*.

Chionographis hisauchiana as here circumscribed (Figs. 1B, 2B–2D) is distributed in more northern regions in Japan (central and northern Honshû) than *C. japonica* (Figs. 1A, 2A; Kyûshû, Shikoku and west to central Honshû) with a very minor overlap in their ranges.

A more detailed account of the variation and taxonomy of the genus *Chionographis* will be forthcoming.

Chionographis hisauchiana (Okuyama) N. Tanaka, comb. et stat. nov. Basionym: *Chionographis japonica* var. *hisauchiana* Okuyama, J. Jap. Bot. 27: 268. 1952. *Chionographis japonica* subsp. *hisauchiana* (Okuyama) H. Hara, J. Jap. Bot. 43: 263. 1968. TYPE: Japan. Honshû: Prov. Musashi [Tôkyô-to], Kasumimura, 3 June 1951, *T. Satow 7594* (holotype, TNS). Figures 1B, 2B.

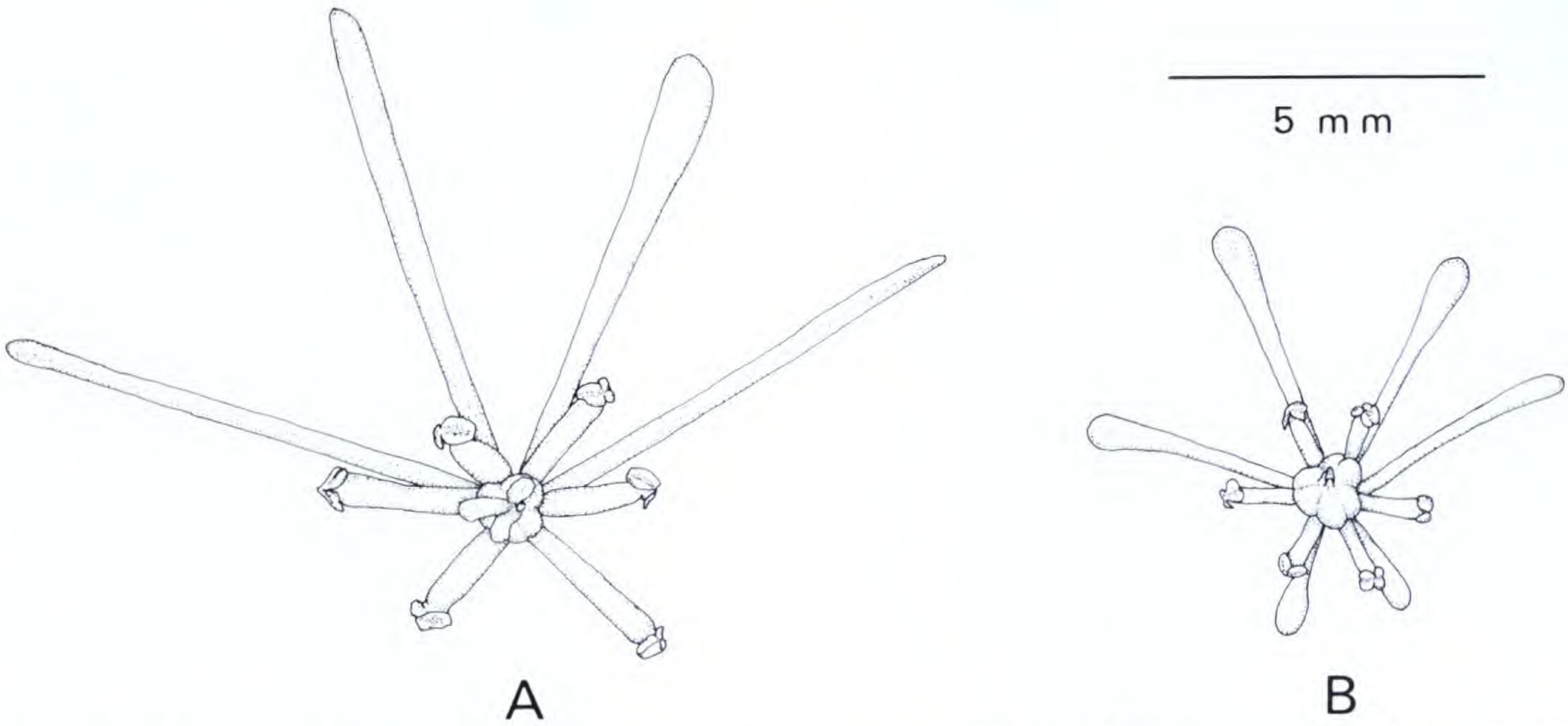

Figure 1. Flowers of *Chionographis* from Japan. —A. *C. japonica* (Willdenow) Maximowicz from Ôsaka, Kôchi Pref., Shikoku (*N. Tanaka 1* (TEU)). —B. *C. hisauchiana* (Okuyama) N. Tanaka subsp. *hisauchiana* from Naguri-mura, Saitama Pref., Honshû (*N. Tanaka 1a* (TEU)). Both flowers bisexual and at same scale. Drawn from living plants.

Selected additional specimens. JAPAN. **Honshû:** Saitama Pref., Iruma-gun, Naguri-mura, 19 Oct. 1990, *N. Tanaka M32B* (TEU), 4 June 1990, *N. Tanaka 1a* (TEU); Saitama Pref., Iruma-gun, Mt. Ogami, 25 May 1952, *M. Mizushima s.n.* (TI); Tôkyô-to, Ôme-shi, Osogi-mura, 23 Oct. 1949, *T. Satow 7495* (TI).

Chionographis hisauchiana subsp. **minoensis** (H. Hara) N. Tanaka, comb. nov. Basionym: *Chionographis japonica* var. *minoensis* H. Hara, J. Jap. Bot. 36: 239. 1961. *Chionographis japonica* subsp. *minoensis* (H. Hara) H. Hara, J. Jap. Bot. 43: 263. 1968. TYPE: Japan. Honshû: Prov. Mino [Pref. Gifu], Yokokura-mura, N of Kanbara, alt. ca. 300 m, 5 June 1961, *H. Hara & S. Kurosawa s.n.* (holotype, TI). Figure 2C.

Selected additional specimens. JAPAN. **Honshû:** Gifu Pref., Motosu-gun, Neo-mura, 26 Mar. 1987, *N. Tanaka 3* (TEU); Gifu Pref., Gujô-gun, Gujô-hachiman, Nabi, 17 Sep. 1967, *K. Inami s.n.* (TNS-184890); Gifu Pref., Mino, Natsuzaka, 29 May 1968, *H. Hara & S. Kurosawa s.n.* (TI).

Chionographis hisauchiana subsp. **kurohimensis** (Ajima & Satomi) N. Tanaka, comb. et stat. nov. Basionym: *Chionographis japonica* var. *kurohimensis* Ajima & Satomi, J. Geobot. 24: 48. 1976. TYPE: Japan. Honshû: Pref. Niigata, Mt. Kurohime, 21 June 1975, *T. Ajima 4546* (holotype, KANA-83861). Figure 2D.

Selected additional specimens. JAPAN. **Honshû:** Niigata Pref., Santô-gun, Koshiji-chô, Hakama, 13 May 1980, *N. Tanaka 7* (TEU); Niigata Pref., Murakami-shi, Kashio, 2 June 1963, *Y. Ikegami 56443* (TNS-162516); Niigata Pref., Kariwa-gun, Mt. Hachikoku, 30 May 1952, *S. Iwano s.n.* (KANA-13338).

Selected specimens of Chionographis japonica. JAPAN. **Kyûshû:** Nagasaki Pref., Mt. Unzen, June 1934, *T. Makino s.n.* (MAK-137210); Kagoshima Pref., Koshiki Isl., Shimo-koshiki-mura, Nagahama, 31 July 1961, *A. Nitta s.n.* (KYO). **Shikoku:** Kôchi Pref., Ôsaka, 4 June 1984, *N. Tanaka 1* (TEU); Kôchi Pref., Sakawa, 26 May 1889, *T. Makino s.n.* (MAK-137200). **Honshû:** Hiroshima Pref., Taishakukyô, 1 June 1984, *N. Tanaka 1* (TEU); Gifu Pref., Motosu-gun, Neo-mura, 25 May 1910, *M. Matsui s.n.* (MAK-137171).

KEY TO FOUR TAXA OF *CHIONOGRAPHIS* OCCURRING IN JAPAN

1a. Flowers with lower 2 tepals vestigial, with 1 or both often absent (Fig. 1A); main veins of leaf blades obscurely impressed and fine veins tending to be slightly elevated adaxially (Fig. 2A); leaf blades usually opaque adaxially; plants usually hermaphrodite but self-incompatible; $2n = 24$ . . . . . *C. japonica*

1b. Flowers with lower 2 tepals shorter than upper ones but always present (Fig. 1B); main veins of leaf blades clearly impressed and fine veins not elevated adaxially; leaf blades lustrous or nearly opaque adaxially (Fig. 2B–2D); populations usually gynodioecious, sometimes hermaphrodite where hermaphroditic individuals self-compatible; $2n = 42$ or 44.

2a. Leaf blades nearly opaque adaxially (Fig. 2B), comparatively thin; upper tepals 2.7–5.7 mm long (Fig. 1B); $2n = 42$ . . . . . *C. hisauchiana* subsp. *hisauchiana*

2b. Leaf blades lustrous adaxially (Fig. 2C, 2D), comparatively thick; upper tepals 3.6–12.0 mm long.

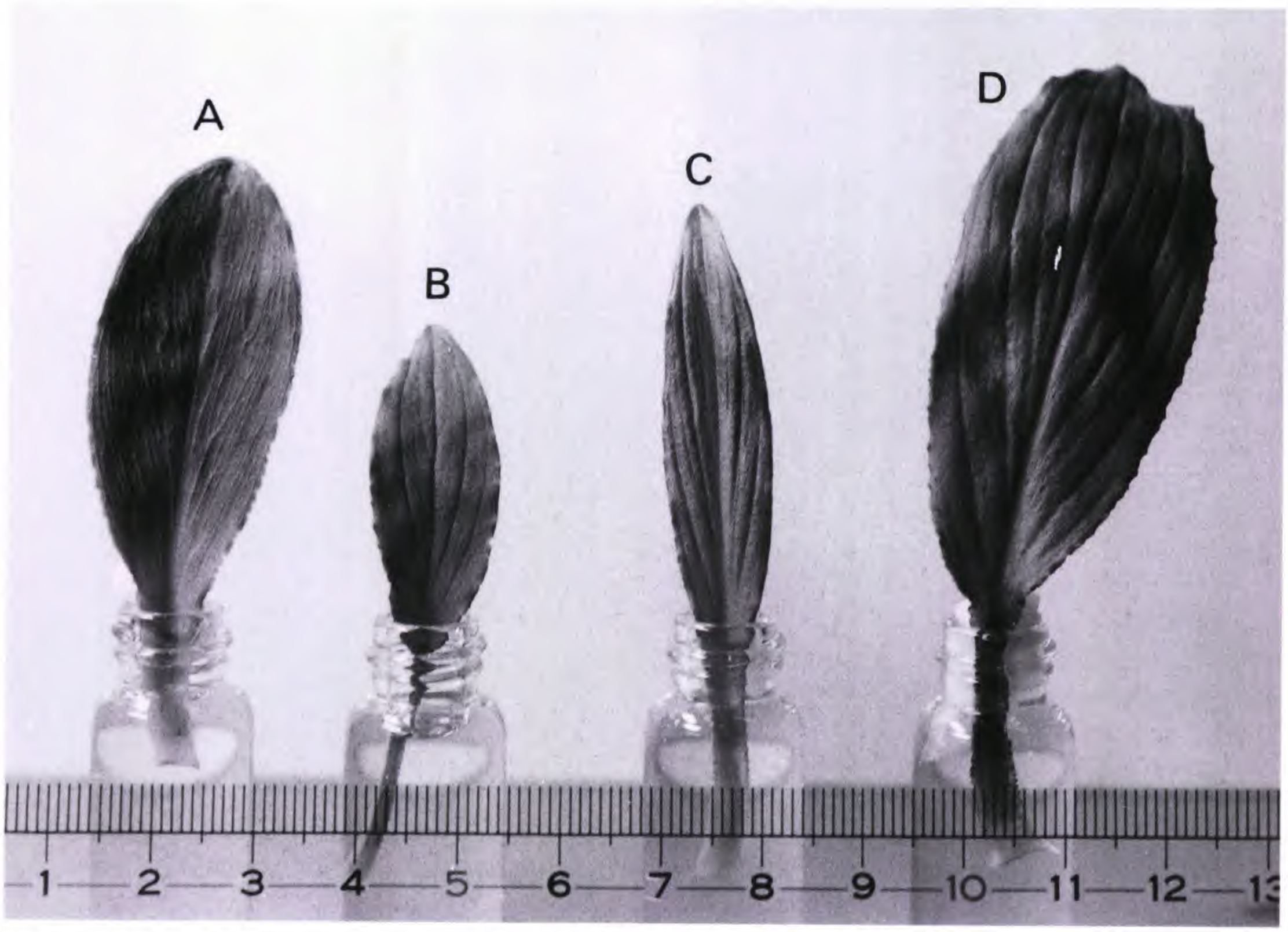

Figure 2. Leaves of four taxa of *Chionographis* from Honshû, Japan. —A. *C. japonica* (Willdenow) Maximowicz from Taishakukyô, Hiroshima Pref. (*N. Tanaka 1* (TEU)). —B. *C. hisauchiana* (Okuyama) N. Tanaka subsp. *hisauchiana* from Naguri-mura, Saitama Pref. (*N. Tanaka M32B* (TEU)). —C. *C. hisauchiana* subsp. *minoensis* (H. Hara) N. Tanaka from Neo-mura, Gifu Pref. (*N. Tanaka 3* (TEU)). —D. *C. hisauchiana* subsp. *kurohimensis* (Ajima & Satomi) N. Tanaka from Hakama, Niigata Pref. (*N. Tanaka 7* (TEU)). All from living plants in cultivation.

3a. Leaf blades usually narrowly elliptic or narrowly oblong (Fig. 2C); main veins usually deeply impressed adaxially; upper tepals 3.6–6.9 mm long; $2n = 42$ . . . . . *C. hisauchiana* subsp. *minoenisis*

3b. Leaf blades usually elliptic to oblong (Fig. 2D); main veins moderately impressed adaxially; upper tepals 3.7–12.0 mm long; $2n = 44$ . . . . . *C. hisauchiana* subsp. *kurohimensis*

In the above key the ranges of variation in tepal length of the three subspecies of *C. hisauchiana* are based on the following samples: subspecies *hisauchiana*, 33 individuals from 1 locality; subspecies *minoenisis*, 35 from 1; subspecies *kurohimensis*, 446 from 13. The ranges include measurements of both female and hermaphrodite plants.

Acknowledgments. I am most grateful to the keepers of KANA, KYO, MAK, TI, and TNS for permission to examine their specimens. I also express my deep gratitude to Roy E. Gereau (MO), R. J. F. Henderson (BRI), and Victoria C. Hollowell (MO) for their critical reviews of the manuscript.

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Rubiacearum Americanarum Magna Hama Pars XII. A New Species of *Ixora* (Ixoreae) from Panama

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ABSTRACT. The new species *Ixora knappiae* C. M. Taylor (Rubiaceae) from the San Blas region of Panama, described and illustrated here, is notable for its opposite, subsessile, basally rounded to cordate leaves.

Key words: *Ixora*, Ixoreae, Mesoamerica, Panama, Rubiaceae.

The pantropical genus *Ixora* L. (Ixoreae; Andreason & Bremer, 2000) comprises about 300 to 400 species of shrubs and small trees found in moist and wet vegetation (De Block, 1998). The majority of *Ixora* species are found in Asia, and this genus is also well represented in Africa, Madagascar, and the Neotropics. *Ixora* has perhaps 30 Neotropical species, where as noted by De Block (1998) it is quite poorly studied. Several Asian species are widely cultivated in tropical regions; a key to these was presented by Bridson (1988). *Ixora* has never been reviewed as a whole for the Neotropics, though it has been treated floristically for some Neotropical regions, notably by Steyermark (1967, 1974). *Ixora* was long included in the tribe Pavetteae (Robbrecht, 1993; De Block, 1998), but more recent work (Andreason & Bremer, 2000) has shown that it is better placed in a separate Ixoreae.

In the Neotropics *Ixora* is distinguished within the Rubiaceae by its stipules that are interpetiolar, narrowly triangular, generally persistent, and often also shortly united intrapetiolarly; its calyx limbs that are four-lobed with the lobes often narrowly triangular to linear; its salverform corollas with the tubes generally glabrous internally; its corolla lobes four, elliptic to ovate, and convolute in aestivation; its stamens four and usually inserted in the corolla throat on short filaments with the anthers partially exserted; its stigmas two, short, and exserted; its ovary bilocular with the ovules solitary in each locule and apically attached; and its fleshy drupaceous fruits with the pyrenes two, planoconvex, generally smooth dorsally (i.e., abaxially), and usually rather thin-walled. The leaves lack domatia, of either foveolate or pilosulous form. The inflorescences are generally corymbiform and bracteate, and may be terminal, cauliflorous, or ramiflorous. The fragrant flowers are homostylous and generally white, yellow, or red. In her excellent revision of *Ixora* in Africa, De Block (1998) also highlighted the petiole bases, which are articulated from the stems (at least in dried specimens) in *Ixora*, as a good character for recognition of this genus. This character is found in Neotropical *Ixora* species as well. Other Neotropical Rubiaceae genera have not yet been widely surveyed for this feature; articulated petiole bases are known in a few other paleotropical genera, of several different tribes. The inflorescence axes of *Ixora* are also usually articulated, often giving them a distinctive appearance when dry.

The flowers of *Ixora* exhibit an adaptation for pollination that is more common in Rubiaceae of the Paleotropics than the Neotropics, called secondary pollen presentation. The flowers of *Ixora* species are protandrous, and the anthers in bud are held closely around the style and stigmatic arms. Rather than presenting their pollen directly to pollinators, the anthers release and transfer some or all of their pollen onto the upper part of the style and the non-receptive abaxial surfaces of the stigmatic arms. Then this transferred pollen is exposed to pollinators for some period of time on these structures; after this the stigmatic arms separate and the stigmatic surfaces become receptive.

The inflorescences of *Ixora* are considered terminal, most often arising directly from the apices of the main stems but sometimes borne on short lateral stems produced in the leaf axils. These lateral stems are called short shoots bearing terminal inflorescences by De Block (1998). In some Neotropical species the stem portion of these short shoots may be reduced so that the inflorescences appear to be axillary (e.g., *I. yavitensis* Steyermark). The inflorescences of *Ixora* are usually regularly branched with the higher order axes as well developed as the axis from which they branch; this condition was called "trichotomous" by De Block (1998). The inflorescences may vary markedly among species of *Ixora* in their degree of expansion, from strongly congested, with the axes only

shortly developed and the flowers sessile and subsessile, to relatively very open with the axes and pedicels all well developed. As in other Rubiaceae, similar inflorescence arrangements have sometimes been described in different ways. De Block (1998) considered the inflorescences to be either pedunculate or sessile; sessile inflorescences comprise three main units or partial inflorescences, which are the parts of the inflorescence borne from, respectively, the two lateral peduncles or basalmost secondary axes, and the central peduncle or primary axis above its junction with that basalmost pair of secondary axes. This sessile arrangement, with three axes or peduncles each bearing branched higher order axes and flowers, was called "trichotomous" by Steyermark (1974). The distinction between sessile and pedunculate inflorescences has been considered less significant in studies of Neotropical *Ixora*, where inflorescence arrangement is considered more irregularly variable in general and several species may have either condition with the peduncle length varying continuously (e.g., *I. acuminatissima* Müller Argoviensis, Steyermark, 1974; *I. floribunda* (A. Richard) Grisebach, Dwyer, 1980).

A number of distinctive characters vary within the genus. The leaves may be opposite, ternate, or infrequently verticillate, and frequently have a distinctive venation pattern. This pattern has the secondary veins relatively weakly developed but the intersecondary veins numerous and relatively well marked, so these types of veins are difficult to distinguish and the blade appears densely venose. The presence vs. absence of pubescence on the external surface of the corolla has been given significant taxonomic weight (e.g., Steyermark, 1967) though it is known to vary within some species of *Ixora* (e.g., De Block, 1998). This corolla pubescence is often very short, and should be examined with good magnification. As noted above, several species show continuous variation in inflorescence arrangement from sessile to subsessile or pedunculate with the peduncles well developed.

The species described below was discovered during study of Rubiaceae collections from Central America for the *Flora Mesoamericana* project.

Ixora knappiae C. M. Taylor, sp. nov. TYPE: Panama. Colón: end of Santa Rita Ridge Road, 21 km from Transisthmian Highway, 400–500 m, 9°25′N, 79°37′W, 22 May 1982, *S. Knapp & R. Schmalzel 5234* (holotype, MO-5333614). Figure 1.

Haec species a congeneris foliis subsessilibus base rotundatis cordulatisve, inflorescentia terminali pedicellos usque ad 3 mm longos gerente atque corollae albae extus glabrae tubo 3.5–4 mm longo ac lobulis ca. 1.5 mm longis distinguitur.

Shrubs to 3.5 m tall, stems glabrous. *Leaves* opposite, elliptic to oblanceolate, 10–19 × 4–7.5 cm, at apex acute to acuminate, at base rounded to shortly cordate, drying chartaceous, glabrous on both surfaces; secondary veins 6 to 13 pairs, reticulating or weakly looping to interconnect near margins; petioles 1–2 mm long; stipules persistent, interpetiolar, triangular, 2.5–3 mm long, glabrous on both surfaces, abaxially costate, aristate with aristas 2–3 mm long. *Inflorescences* borne at the apices of the main stems, pyramidal in outline, 4–5 × 4–5 cm, subsessile, lax, puberulous; bracts subtending axes triangular, 0.5–1 mm long, acute, those subtending flowers triangular to lanceolate, ovate, or ligulate, 0.5–0.8 mm long, acute; pedicels 0–3 mm long; *flowers* sessile and shortly pedicellate in 2- to 3-flowered dichasial cymules; hypanthium ellipsoid, 1–1.5 mm long, puberulous; calyx limb 0.5–0.8 mm long, denticulate, puberulous; *corolla* salverform, white, externally sparsely puberulous, internally glabrous, tube 3.5–4 mm long, lobes elliptic, ca. 1.5 mm long, obtuse to rounded; anthers ca. 1.2 mm long, partially exserted; stigmas 2, lanceolate to spatulate, ca. 0.8 mm long, exserted. *Fruits* subglobose, 6–7 mm diam., glabrescent, mature color unknown.

Distribution, habitat, and phenology. In wet forests at 250–500 m in eastern and central Panama; collected in flower in May, in fruit in October.

This new species is distinguished from other Neotropical species of *Ixora* by its combination of opposite leaves that are subsessile and rounded to shortly cordate at the base; its inflorescences borne at the apices of the main stems with pedicels to 3 mm long; its white corollas that are sparsely puberulous externally; and its corollas with tubes 3.5–4 mm long and lobes ca. 1.5 mm long. A few other Neotropical species of *Ixora* share with *I. knappiae* subsessile leaves with rounded to cordate bases; their distinctions from *I. knappiae* are outlined below. *Ixora acuminatissima* of Amazonian South America can often be distinguished from *I. knappiae* by its ternate leaf arrangement, though occasional plants of this species do have opposite leaves, and *I. acuminatissima* can reliably be separated by its larger corollas, with the tube 6–10 mm long and the lobes 3–4 mm long. *Ixora intropilosa* Steyermark is found on tepuis in Guyana and eastern

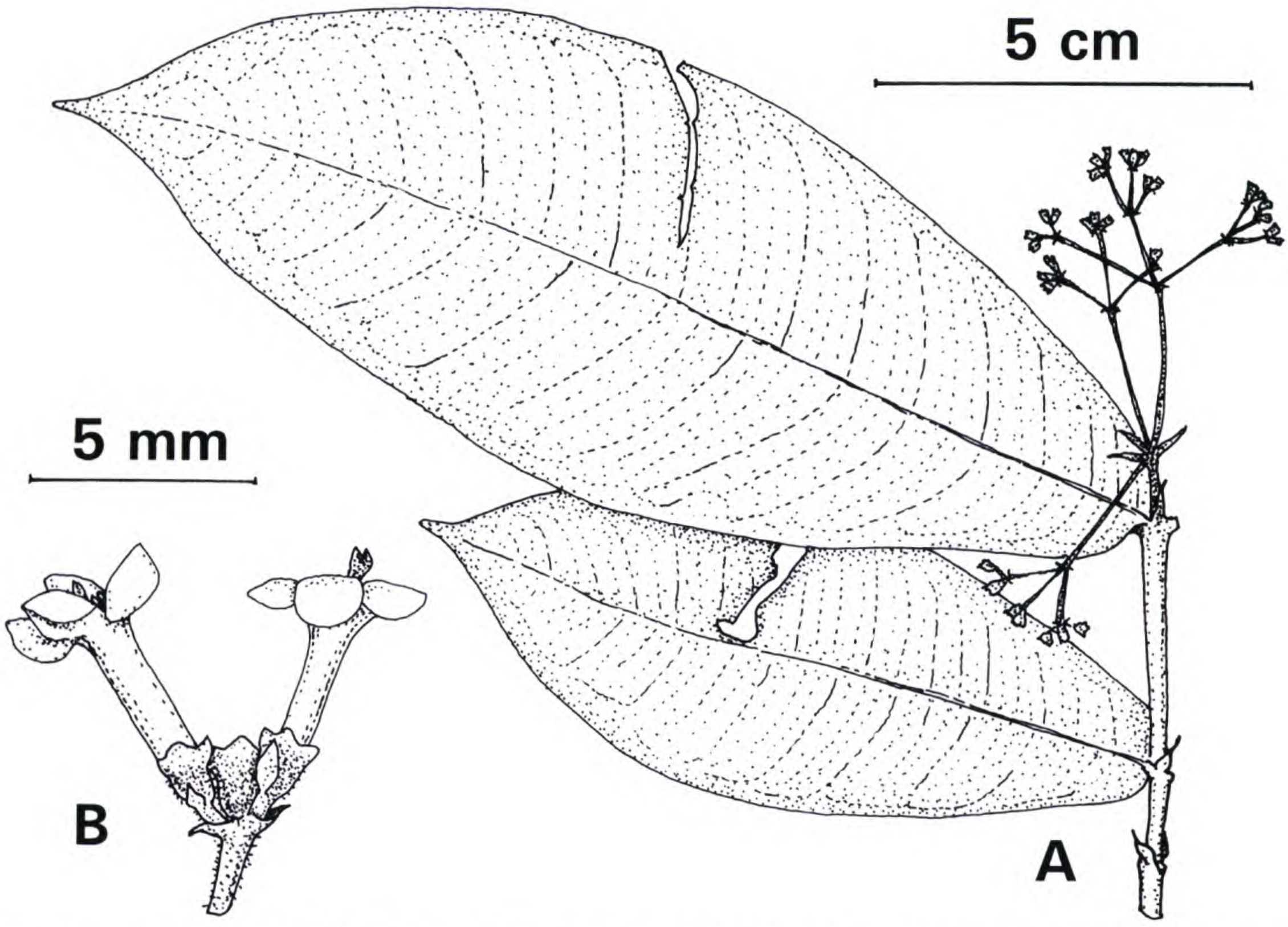

Figure 1. *Ixora knappiae* C. M. Taylor. —A. Flowering branch; based on *de Nevers & Charnley 5916*. —B. Detail of inflorescence showing cymule with two flowers at anthesis; based on *Knapp & Schmalzel 5234*.

Venezuela, and can also be distinguished from *I. knappiae* by its larger corollas, with the tube 8–12 mm long and the lobes ca. 3.5 mm long. *Ixora piresii* Steyermark of northeastern Brazil and the Guianas can be distinguished from *I. knappiae* by its ternate leaves 29–33 cm long, its peduncles ca. 5.5 cm long, and its larger corollas with the tube ca. 16 mm long and the lobes ca. 7 mm long. *Ixora potaroensis* Steyermark of Guyana differs from *I. knappiae* in its leaves 32–48 cm long arranged in verticils of four and its peduncles 12.5–14 cm long. (*Ixora potaroensis* was described based on a single fruiting specimen, and may not be distinct from *I. piresii*.) And, some plants of *I. killipii* Standley, a species of Amazonian Ecuador, Peru, Colombia, and adjacent Brazil, also have very short petioles and abruptly rounded to truncate leaf bases; *I. killipii* can be distinguished from *I. knappiae* by its flowers all borne on pedicels 2–10 mm long and its larger corollas, with the tube 25–30 mm long and the lobes 8–9 mm long.

The specific epithet honors Sandra Knapp, a prolific taxonomist and collector of the Neotropical flora.

Paratypes. PANAMA. **San Blas:** El Llano–Cartí Road, Km 16.7, trail W to waterfall 5 km from road, 9°19′N, 78°55′W, *de Nevers & Charnley 5916* (MO); Campamento Nusagandi, en ELC a 19.1 km de la vía Panamericana, Sendero Wedar Igar, 9°11′N, 78°15′W, *H. Herrera et al. 1263* (MO).

Acknowledgments. I thank the curators of F and PMA, in particular M. Correa, for access to specimens and providing information; R. E. Gereau for preparation of the Latin diagnosis; P. De Block for an invaluable review; T. Wachter, R. Foster, and the Andrew Mellon Foundation through a grant to the Field Museum of Natural History for support for travel to that institution; and R. Magill and O. M. Montiel for their significant facilitation of this work.

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Rubiacearum Americanarum Magna Hama Pars XIII. A New Species of *Schradera* (Schradereae) from Mesoamerica

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Abstract. The new species *Schradera obtusifolia* C. M. Taylor (Rubiaceae) from Costa Rica and Panama is described and illustrated. This has previously been confused with *S. costaricensis* Dwyer, which also has obtuse to rounded leaf apices.

Key words: Costa Rica, Panama, Rubiaceae, *Schradera*.

Schradera Vahl (Schradereae; Robbrecht, 1993) is a tropical genus of succulent, lianescent, epiphytic shrubs that climb by adventitious roots. This genus is distinguished by its habit, which is unusual in the Rubiaceae, together with its interpetiolar, relatively large, ligulate to elliptic stipules that are quickly caducous, its terminal capitate inflorescences with the heads usually surrounded by a well-developed involucre, its truncate, usually tubular calyx limb, its succulent, salverform, white corollas with the tubes often rather stout, its corolla lobes five to six, valvate, triangular in cross section, and apically prolonged beyond the contact zone into a terminal appendage, its bilocular ovaries with axile placentas bearing numerous ovules, and its fleshy fruits with numerous seeds embedded in the pulp. The flowers are distylous and apparently nocturnal with a sweet fragrance similar to that of gardenias. At least some species have markedly different leaf forms in the juvenile and reproductive stages (e.g., *S. vahlii* Steyermark, pers. obs., Puerto Rico).

The corolla lobes are unusual in form in *Schradera*. These corolla lobes have been referred to as valvate plus, variously, "hooded" (Puff et al., 1993), with an appendage (Steyermark, 1974), or with a cucullate tooth (Steyermark, 1963). The corolla lobes of *Schradera* are typically very fleshy and flattened to triangular in cross section. They are valvate in bud with the margins of adjacent lobes in contact along part or most of their length, but at the apex they are typically prolonged into another portion that is not in contact with the other lobes. Enlargements or prolongations of the abaxial or apical portion of valvate corolla lobes are found in some other Neotropical Rubiaceae, in both diurnal and nocturnal flowers (e.g., *Palicourea cornigera* C. M. Taylor, *Rudgea tayloriae* Aymard, Dorr & Coello, *Psychotria cornigera* Bentham, *Faramea uncinata* C. M. Taylor). The function of these structures is unknown.

Schradera was long treated as a Neotropical genus of about 30 species and placed in the tribe Schradereae together with the genus *Lucinaea* DC. of southeastern Asian and the southwestern Pacific islands. More recently Puff et al. (1993) reviewed this tribe in detail and concluded that no morphological differences separate *Schradera* from *Lucinaea*, and therefore these are better combined. The name *Schradera* Vahl was published in 1796 and consequently has priority over *Lucinaea* DC., published in 1830. (*Schradera* Vahl is conserved against *Schradera* Heister ex Medicus, published in 1791.) Puff et al. (1993) formally synonymized *Lucinaea* under *Schradera*, but did not make combinations in *Schradera* for any of species of *Lucinaea*. Subsequently Puff et al. (1998) studied some of the paleotropical species of *Schradera* and published new combinations for these, but the rest of the paleotropical species and all of the Neotropical species are poorly known. In the Neotropics *Schradera* is found from Costa Rica to Peru, through Venezuela to the Guianas and eastern Brazil, and in the Antilles from Hispaniola though the Lesser Antilles to Trinidad. For the Neotropics *Schradera* has only been treated floristically for a few regions, notably by Steyermark (1963).

The following new species was discovered during preparation of the Rubiaceae for *Flora Mesoamericana*. *Schradera* is difficult to study in large part because of its sporadic collection, as with most epiphytes, due to its habit, with the flowers usually produced in the forest subcanopy and canopy. Once collected, specimens are usually difficult to intepret because of their succulent tissues, which often make poor specimens. Thus the range of variation generally found within an individual species in supposedly taxonomically informative characters such as number of flowers per inflorescence head, corolla size, or peduncle length is not yet clear.

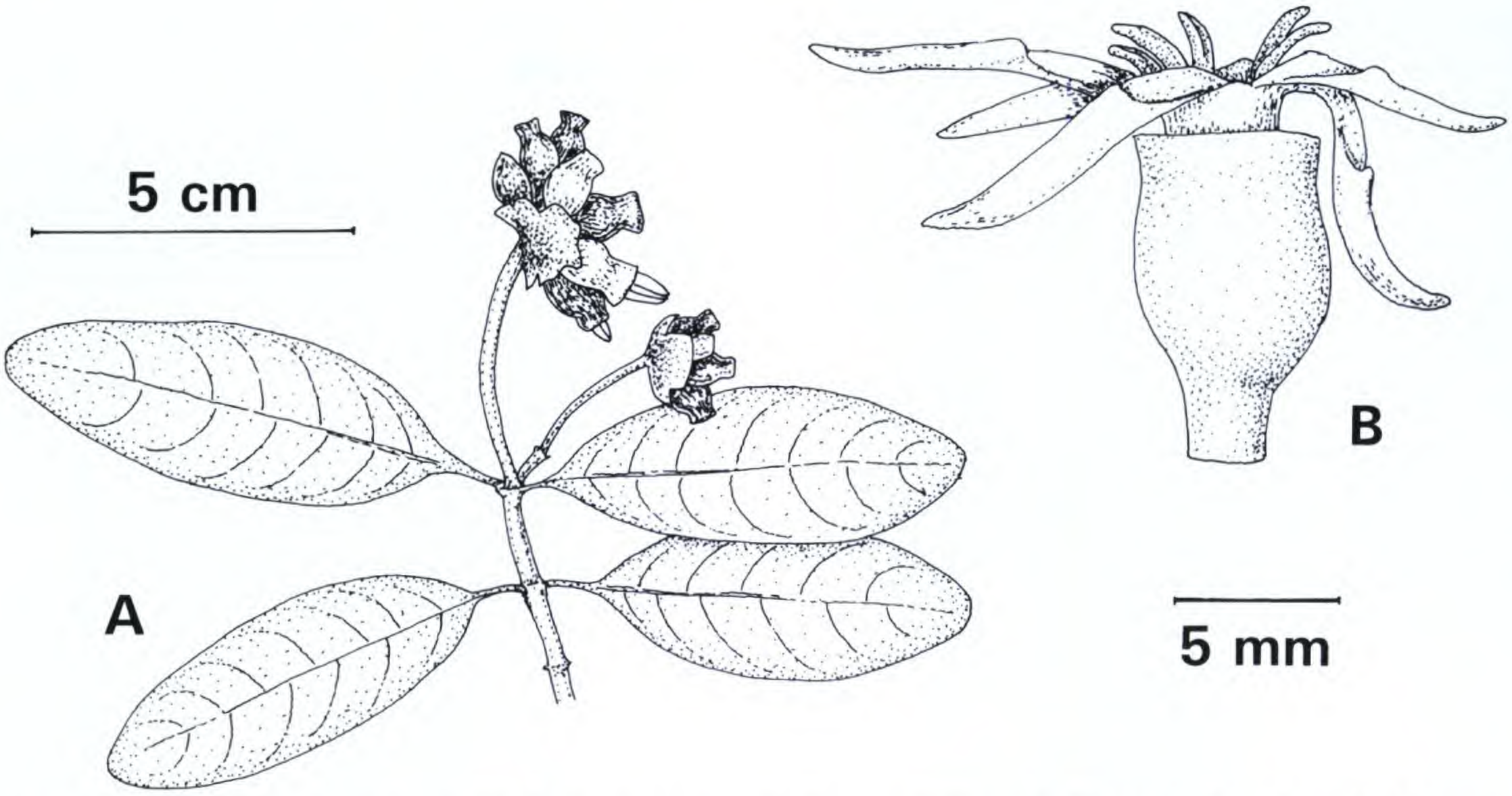

Figure 1. *Schradera obtusifolia* C. M. Taylor, based on *G. Herrera 3325*. —A. Flowering branch. —B. Flower at anthesis.

Schradera obtusifolia C. M. Taylor, sp. nov. TYPE: Costa Rica. Limón: cantón Talamanca, Alto Urén, siguiendo el camino entre la Quebrada Chaho y Croriña, 9°21′N, 82°59′W, 700 m, 23 July 1989, *G. Herrera 3325* (holotype, CR; isotype, MO-3844960). Figure 1.

Haec species a *Schradera costaricensi* Dwyer inflorescentia 5- ad 10-flora, calycis limbo 5–6 mm longo atque corollae tubo 8–10 mm longo ac lobulis 10–12 mm longis distinguitur.

Glabrous shrubs or lianas. *Leaves* elliptic-oblong, 4–8.5 × 1.5–3.5 cm, at apex obtuse to rounded, at base obtuse, drying subcoriaceous; secondary and higher-order venation not visible; petioles 5–20 mm long; *stipules* interpetiolar, caducous, ligulate to elliptic, ca. 15 mm long, obtuse to rounded. *Inflorescences* terminal; peduncles 1 to 3, 1–4 cm long, each bearing one head; heads hemispherical to subglobose, 1.5–2.5 cm diam. (not including corollas), 5- to 10-flowered; involucre continuous, 8–9 mm long, truncate though sometimes splitting along the margins and appearing irregularly lobed; *flowers* with hypanthium ellipsoid to subglobose or turbinate, 5–6 mm long, glabrous; calyx limb tubular, 5–6 mm long, truncate, glabrous; corollas salverform, white, carnose, glabrous externally and internally, tube 8–10 mm long, lobes 5, linear, 10–12 mm long, at apex with prolongation 3–6 mm long beyond contact zone, acute, triangular to somewhat flattened in cross section; anthers ca. 3 mm long, partially exserted; styles and stigmas not seen. *Fruits* not seen.

Distribution, habitat, and phenology. In wet forests at 250–800 m, Costa Rica and western Panama; collected in flower in June, July, and October.

This new species is similar to and apparently allopatric with *Schradera costaricensis* Dwyer. Both of these species are notable for their obtuse to rounded leaf apices; the species epithet of *S. obtusifolia* refers to this character. Dwyer, Burger, and Taylor (Burger & Taylor, 1993) combined all of the obtuse- to rounded-leaved plants into a single Costa Rican species, but with more collections now available two species can be distinguished among these plants. The type of *S. obtusifolia* was in fact cited there as a paratype of *S. costaricensis*. *Schradera costaricensis* differs from *S. obtusifolia* by its heads with 20 to 40 flowers, its calyx limbs 3–5 mm long, and its corollas with the tubes 8–9 mm long and the lobes 4–5 mm long. *Schradera costaricensis* is found in the Cordillera Tilarán of northern Costa Rica, while *S. obtusifolia* is found in the Cordillera Talamanca of southern Costa Rica through western Panama. These mountain ranges are not continuous and are floristically distinct (Haber, 2000).

Paratypes. COSTA RICA. **Limón:** camino de Fila Dimat (casa de Hermógenes Pereira) hasta Soki pasando por la quebrada, *L. D. Gómez et al. 23853* (F, MO). PANAMA. **Bocas del Toro:** E 1.5 mi. off road from divide to Chiriquí Grande, *D'Arcy 16382* (MO).

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brecht and P. De Block for excellent reviews and significant help improving the manuscript; T. Wachter, R. Foster, and the Andrew Mellon Foundation through a grant to the Field Museum of Natural History for support for travel to that institution; and R. Magill and O. M. Montiel for their significant facilitation of this work.

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Rubiacearum Americanarum Magna Hama Pars XIV. New Species of *Malanea* (Guettardeae) from Western South America

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ABSTRACT. The new species *Malanea campylocarpa* from the western Amazon basin, *M. cylindrica* from east-central Peru, and *M. ecuadorensis* from east-central Ecuador are described and illustrated here. These are all notable for their cylindrical fruits, and all have previously been confused with *M. boliviana* Standley. A key to *Malanea* in western South America includes eight species.

Key words: Guettardeae, *Malanea*, Rubiaceae, South America.

The Neotropical genus *Malanea* Aublet (Guettardeae; Robbrecht, 1993) comprises about 35 species of lianas, woody vines, and shrubs found in moist and wet vegetation from southeastern Nicaragua to eastern Brazil and northern Bolivia. The genus has not been reviewed as a whole, and in general has been rather poorly studied. The majority of its species are found in northeastern South America, most of them in the Guayana region. Steyermark (1965) reported 25 species, though several of these were based on only one or two specimens and distinguished only by the density and distribution of their pubescence; they deserve reevaluation when more specimens are available.

Malanea is distinguished by the combination of its usually climbing habit; its leaves with lineolate venation; its interpetiolar, generally caducous stipules; its axillary inflorescences; its corollas with the tubes relatively short and the lobes valvate in bud; and its fleshy fruits each with a single hard pyrene. This distinctive lineolate venation pattern has the tertiary veins closely parallel, though these veins and thus this feature are not readily visible in many species of *Malanea*. Such lineolate venation is found in many species of the Guettardeae as well as several other Rubiaceae tribes (e.g., *Hippotis* Ruiz & Pavón, Hippotideae; *Sommera* Schlechtendal, Hippotideae; *Joosia* H. Karsten, Cinchoneae). The vining or liana habit of many species of *Malanea* is relatively uncommon among Neotropical Rubiaceae. However, it is found in a few species of other genera belonging to both the Guettardeae (e.g., *Chomelia stergiosii* Steyermark, *C. volubilis* (Standley) Steyermark) and other tribes (e.g., *Uncaria guianensis* (Aublet) J. F. Gmelin, Naucleeae; *Randia altiscandens* (Ducke) C. M. Taylor, Gardenieae). The delimitation of the Neotropical genera of Guettardeae is largely traditional and probably deserves reevaluation, in particular the recognition of *Malanea* based primarily on its climbing habit.

The flowers of *Malanea* are generally pale green to white, yellow, or orange, and thus probably insect-pollinated. The corollas are usually densely pubescent in the tube and throat, and often this pubescence extends onto the corolla lobes. The species of *Malanea* that have been studied have homostylous flowers, although flowers are known for only a few species so the occurrence of distyly in this genus cannot yet be excluded. Distyly is present in some species of the related genera *Chomelia* Jacquin and *Guettarda* L. The succulent fleshy fruits of *Malanea* are presumed to be dispersed by animals.

The species described below were discovered during preparation of the Rubiaceae treatment for the *Flora of the Venezuelan Guayana*. A key is presented here to all the *Malanea* species known from western South America, in this case comprising Bolivia, Peru, Ecuador, and Colombia.

KEY TO THE SPECIES OF *MALANEA* IN WESTERN SOUTH AMERICA

1. Inflorescences spiciform, unbranched or with 1 to 2 pairs of secondary axes, with the flowers borne in sessile glomerules along the primary and secondary axes; dried fruits cylindrical, similar in diameter throughout; pyrenes 1-locular.
2. Plants hirsute throughout, the trichomes long and spreading; bracts 3–12 mm long . . . . . *M. ecuadorensis* C. M. Taylor
2′. Plants strigose to strigillose throughout, the trichomes appressed; bracts 1–3.5 mm long.
3. Fruits strongly curved; leaves 9–20 × 4–10 cm; corolla pale green, with the tube ca. 2 mm long . . . . . *M. campylocarpa* C. M. Taylor
3′. Fruits straight or slightly curved; leaves 4.5–13 × 2–7.5 cm; corolla yellow-orange, with the tube ca. 4 mm long . . . . . *M. cylindrica* C. M. Taylor

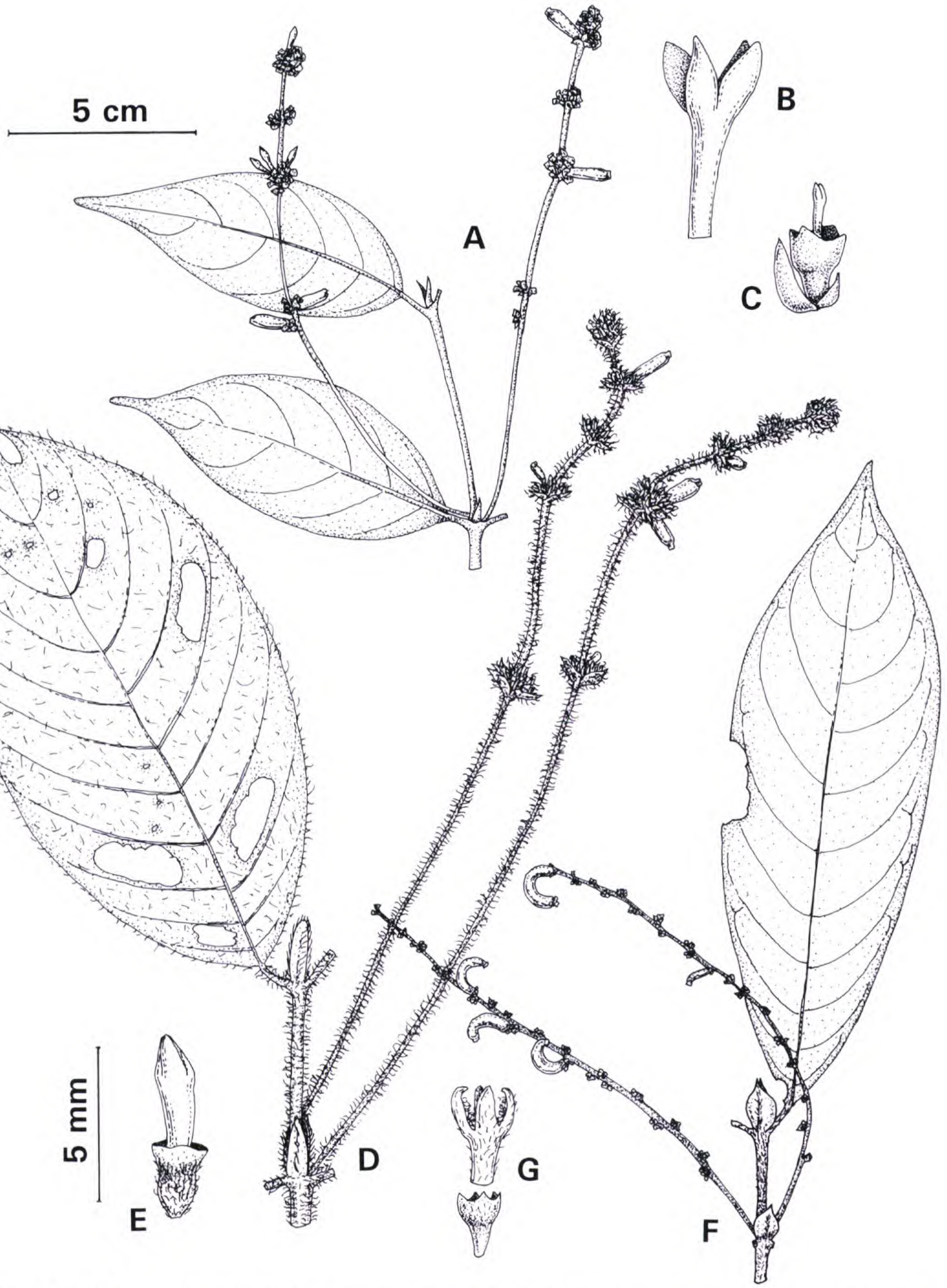

Figure 1. A–C, *Malanea cylindrica* C. M. Taylor; based on *Schunke V. 7696.* —A. Stem with leaves and two inflorescences with developing fruits. —B. Corolla. —C. Detail of flower showing calyx limb, hypanthium, style, stigmas, and two floral bracts. D, E, *Malanea ecuadorensis* C. M. Taylor. —D. Stem with leaf and two infructescences; based on *Coello 19.* —E. Flower bud; based on *Cerón 3922.* F, G, *Malanea campylocarpa* C. M. Taylor. —F. Stem with leaf and two infructescences; based on *Neill 8938.* —G. Flower, partially dissected; based on *Cerón 6030.* A, D, F to 5-cm scale; B, C, E, G to 5-mm scale.

1′. Inflorescences thyrsiform-paniculate, with 1 to several pairs of developed secondary axes, with the flowers borne in sessile glomerules or cymules along the primary, secondary, and tertiary axes; dried fruits ellipsoid to fusiform, widest in the middle; pyrenes 2-locular.
  4. Leaves on abaxial surface densely sericeous to velutinous, the lamina surface not visible, covered by silvery gray pubescence . . . . . *M. macrophylla* Bartling ex Grisebach
  4′. Leaves on abaxial surface sparsely strigillose to rather densely hirtellous, the lamina surface visible and the pubescence not noticeably silvery gray.
    5. Leaves at apex obtuse to rounded and sometimes shortly cuspidate, abaxially with pubescence spreading.
      6. Leaves with margins plane; stipules obtuse to rounded; fruits 4–5 mm long; Pacific coastal Colombia . . . . . *M. chocoana* Standley ex Steyermark
      6′. Leaves with margins plane or frequently revolute; stipules obtuse to acute or acuminate; fruits 6–8 mm long; Amazon basin of Peru . . . . . *M. sarmentosa* Aublet
    5′. Leaves at apex acute to acuminate or cuspidate, abaxially with pubescence appressed.
      7. Inflorescences with the axes unbranched and spiciform, the flowers borne in glomerules; calyx limb 1.2–1.5 mm long; Amazon basin of Ecuador, Peru, and Bolivia . . . . . *M. boliviana* Standley
      7′. Inflorescences with the axes branched and thyrsiform-paniculate, the flowers borne in branched cymules; calyx limb 0.5–1 mm long; Pacific coastal Colombia and northwestern Ecuador . . . *M. erecta* Seemann

Malanea campylocarpa C. M. Taylor, sp. nov. TYPE: Ecuador. Napo: Canton Tena, Estación Biológica Jatun Sacha, Río Napo, 8 km al E de Misahuallí, 1°04′S, 77°36′W, 400 m, 14 Apr. 1991, *W. Palacios 7068* (holotype, QCNE; isotype, MO-5568801). Figure 1F, G.

Haec species a congeneris foliis satis grandibus, inflorescentia spiciformi satis longa atque fructu cylindrico valde arcuato distinguitur.

Lianas or perhaps epiphytic shrubs, height unknown; stems densely strigose. *Leaves* elliptic to narrowly so or obovate, 9–20 × 4–10 cm, at apex acute to acuminate with tips 1–1.5 cm long, at base cuneate to obtuse or shortly rounded, drying chartaceous, adaxially glabrous or strigillose along costa, abaxially strigillose on veins with trichomes regularly ordered along and perpendicular to tertiary veins; secondary veins 8 to 11 pairs, not or weakly looping to interconnect near margins, without domatia, adaxially costa plane to prominulous, secondary veins plane to impressed, and remaining venation plane, abaxially costa prominent, secondary veins prominulous, and remaining venation plane to thickened; petioles 6–12 mm long; *stipules* caducous, elliptic to obovate, 10–16 mm long, obtuse to acute, abaxially glabrous or usually strigillose near base and along medial line. *Inflorescences* densely strigillose, spiciform, often flexuose, unbranched or infrequently with 1 to 2 pairs of spiciform secondary axes; peduncles 2–6 cm long; flower-bearing portion 7–18 × 1–1.5 cm, with flowers in 8 to 30 glomerules of 5 to 15; bracts 1–3.5 mm long, linear to narrowly triangular, acute; *flowers* sessile; hypanthium cylindrical, 1.5–2 mm long, glabrous; *calyx* limb ca. 1.2 mm long, sparsely strigillose, lobed for 1/4–1/3, lobes obtuse to acute; *corolla* salverform, pale green, externally moderately to densely strigillose, internally densely hirtellous throughout tube and on lobes, tube ca. 2 mm long, lobes narrowly ligulate, ca. 2 mm long, acute; *anthers* ca. 1 mm long, exserted; *style* and *stigmas* not seen. *Fruits* cylindrical, strongly curved, ca. 12 × 3 mm, glabrous, blue-black; pyrene 1, smooth, 1-locular.

Distribution, habitat, and phenology. In wet forests on the eastern slopes of the Andes, at ca. 260 m in central Peru, at 400–480 m in Ecuador, and to 1420 m in southwestern Colombia; collected in flower in January, in fruit in January, March, and April.

Malanea campylocarpa is distinguished by its relatively large leaves, relatively long spiciform inflorescences, and cylindrical, strongly curved fruits with the pyrene apparently 1-locular. The strongly curved fruits are distinctive; the species epithet refers to this character. Only one flowering collection has been seen, so it cannot be determined if this species is distylous. The distinctions between this and similar *Malanea* species found in the western Amazon basin are discussed under the description of *M. cylindrica*, below.

Paratypes. COLOMBIA. **Putumayo:** mpio. Mocoa, correg. San Antonio, vereda Alta Campucana, Finca La Mariposa, 1350–1420 m, *J. L. Fernández et al. 10844* (COL, MO). ECUADOR. **Napo:** Canton Archidona, riberas del Río Alpayacu, Helipuerto 6, Compañía Triton, *H. Vargas & Grefa 865* (MO); Canton Tena, Estación Biológica Jatun Sacha, Río Napo, 8 km al E de Misahuallí, *C. Cerón 6030* (MO), *C. Cerón 6037* (MO), *C. Cerón 6317* (MO), *Gentry et al. 60033* (MO), *Neill 7057* (MO), *Neill 8938* (MO). PERU. **Huánuco:** prov. Pachitea, Dantas, trochas de estudio UNA La Molina, Km 42, carretera marginal, *C. Díaz S. & Baldeón 2305* (MO). **Madre de Dios:** prov. Tambopata, ca. 30 air km or 70–80 river km SSW Puerto Maldonado at afluence [sic; confluence] of Río La

Torre (Río D'Orbigny)/Río Tambopata (SE bank), Tambopata Nature Preserve, *P. J. Barbour 4849* (MO).

Malanea cylindrica C. M. Taylor, sp. nov. TYPE: Peru. San Martín: prov. Mariscal Cáceres, dtto. Tocache Nuevo, Fundo Miramar al N de Tocache, márgen izquierda del Río Huallaga, 450 m, 23 July 1974, *J. Schunke Vigo 7696* (holotype, MO-2736920). Figure 1A–C.

Haec species a *Malanea boliviana* inflorescentia spiciformi simplici, calycis limbo 1.2–1.5 mm longo, corollae tubo ca. 4 mm longo ac lobulis ca. 2 mm longis atque fructu cylindrico 10–11 × ca. 3.5 mm distinguitur.

Lianas or perhaps hemi-epiphytes, height not recorded; stems densely strigose. *Leaves* elliptic to broadly so or lanceolate, 4.5–13 × 2–7.5 cm, at apex acute to usually acuminate with tips 5–15 mm long, at base obtuse to rounded, drying chartaceous to subcoriaceous, adaxially glabrous, abaxially moderately strigillose to strigose with pubescence often denser on principal veins; secondary veins 5 to 6 pairs, extending to margins, without domatia, adaxially venation plane or costa prominulous, abaxially costa prominent, secondary veins prominulous, and remaining venation plane; petioles 4–7 mm long; *stipules* caducous, triangular, 4–10 mm long, acute to usually acuminate, abaxially moderately to densely strigillose especially along medial line, to glabrescent near margins. *Inflorescences* densely strigillose to hirtellous, spiciform, unbranched; peduncles 3–5 cm long; flower-bearing portion 3–9.5 × 1–1.5 cm, with flowers in 2 to 6 sessile glomerules of 3 to 15; bracts deltoid to narrowly triangular, 1–3 mm long, acute; *flowers* sessile; hypanthium turbinate, ca. 1 mm long, glabrous; *calyx* limb 1.2–1.5 mm long, glabrous, sinuate to shallowly lobed, lobes obtuse; *corolla* salverform, yellow-orange, externally and internally glabrous, tube ca. 4 mm long, lobes lanceolate, ca. 2 mm long; *anthers* ca. 1.5 mm long, situated in corolla throat; *stigmas* ca. 0.2 mm long, situated below corolla throat. *Fruits* cylindrical, ca. 10–11 × 3.5 mm, glabrous, dark red, with persistent calyx limb to 2 mm long; pyrene 1, smooth, 1-locular.

Habitat, distribution, and phenology. In wet forests at 400–700 m on Amazonian slopes of central Peru; collected in flower in July, in fruit in July and August.

This new species is similar to and probably sympatric with *Malanea boliviana* Standley. However, it is distinguished by its spiciform, unbranched inflorescences, calyx limbs 1.2–1.5 mm long, corollas with the tube ca. 4 mm long and lobes ca. 2 mm long, and cylindrical fruits 10–11 × 3.5 mm versus inflorescences with at least one pair of developed secondary axes, calyx limbs ca. 0.8 mm long, corollas with the tube ca.1.5 mm long and lobes ca. 1.5 mm long, and fusiform to ellipsoid fruits ca. 7 × 4.5 mm in *M. boliviana.*

The cylindrical fruits are unusual in *Malanea,* most species of which have ellipsoid to fusiform fruits; the specific epithet refers to this character. Cylindrical fruits are also found in two other species of western South America that are both described in this article. *Malanea campylocarpa* differs from *M. cylindrica* in its relatively larger leaves, 9–20 × 4–10 cm, and its pale green corollas with the tube ca. 2 mm long, and from both these other species in its strongly curved fruits. *Malanea ecuadorensis,* too, differs from *M. cylindrica* in its relatively larger leaves, 11–22 × 4–12 cm, and from both these other species in its hirsute pubescence, longer inflorescences with the peduncles 2.5–15 cm long and the flower-bearing portion 2.5–12 cm long, and longer bracts, 3–12 mm long.

The internally glabrous corollas of this species are also unusual in *Malanea.* Only one collection with mature flowers has been seen, so whether this species is distylous cannot be determined.

Paratypes. PERU. **San Martín:** prov. Mariscal Cáceres, dtto. Tocache Nuevo, Quebrada de Santa Rosa de Cachiyacu (carretera a Progreso), *J. Schunke V. 7588* (MO); Quebrada de Huaquisha, márgen derecha del Río Huallaga, *J. Schunke V. 8055* (MO).

Malanea ecuadorensis C. M. Taylor, sp. nov. TYPE: Ecuador. Napo [Orellana]: Yasuní Forest Reserve, 1–3 km E of Pontificia Universidad Católica del Ecuador Science Station, by Tiputini River, 00°41′S, 76°24′W, 240 m, 15 June 1995, *P. Acevedo-Rodríguez & J. A. Cedeño 7327* (holotype, MO-5568802; isotype, US). Figure 1D, E.

Haec species a congeneris pubescentia hirsuta, foliis satis grandibus, inflorescentia spiciformi atque fructu cylindrico recto vel leniter curvato distinguitur.

Lianas or apparently sometimes small shrubs, to 8 m high; stems moderately to densely hirsute. *Leaves* elliptic to elliptic-oblong, 11–22 × 4–12 cm, at apex acuminate with tips 0.5–1 cm long, at base cuneate to usually obtuse or rounded, drying papyraceous, on both surfaces sparsely to moderately hirsute with pubescence denser on costa and secondary veins, often also strigose on principal veins abaxially; secondary veins 9 to 10 pairs, not or weakly looping to interconnect near margins, without domatia, adaxially costa and secondary veins thinly prominulous and remaining venation

plane, abaxially costa prominent, secondary veins prominulous, and remaining venation plane to thickened; petioles 7–20 mm long; *stipules* caducous after 1 to 2 distalmost nodes, narrowly ligulate to triangular, 15–20 mm long, obtuse to usually acute, abaxially glabrous except sparsely to moderately hirsute and strigillose along a medial line, ciliate on margins. *Inflorescences* densely hirsute, spiciform, unbranched, flexuose; peduncles 2.5–15 cm long; flower-bearing portion 2.5–12 × 1–2 cm, with flowers borne in 3 to 8 sessile glomerules of 5 to 15; bracts 3–12 mm long, ovate to lanceolate, acute to somewhat acuminate; *flowers* sessile; hypanthium ellipsoid, ca. 1.5 mm long, hirtellous; *calyx* limb 1–1.2 mm long, glabrous to sparsely hirtellous, truncate to lobed for up to 1/2, lobes ligulate, rounded; *corolla* in bud slenderly funnelform, yellow, externally glabrous, internally not seen, tube to 3 mm long, lobes to 1.2 mm long; *anthers*, *style*, and *stigmas* not seen. *Fruits* cylindrical, 11–12 × 3–4 mm, straight to slightly curved, glabrous except hirtellous on calyx lobes, purple to red; pyrene 1, smooth, 1-locular.

Distribution, habitat, and phenology. In wet forest on terra firme (i.e., land not inundated when rivers rise) at 200–300 m, northeastern Ecuador; collected in flower bud in April and June, in fruit in May and June.

This new species is distinguished by the combination of its hirsute pubescence, relatively large leaves, spiciform inflorescences, and straight to slightly curved cylindrical fruits. *Malanea ecuadorensis* is known only from the type region in Ecuador; the epithet refers to this range. The distinctions between this and other *Malanea* species from the western Amazon basin are discussed under the description of *M. cylindrica*, above. This new species is also similar in its hirsute pubescence to *Malanea ursina* Standley, which is known from the central Amazon basin; *M. ursina* differs from this new species in its generally smaller leaves, 5–8.5 × 2–4.5 cm, with usually 6 pairs of secondary veins; its smaller stipules, ca. 7 mm long; its smaller inflorescences, with peduncles ca. 1.5 cm and the flower-bearing portion ca. 4 × 1 cm; and its shorter calyx limbs, ca. 0.8 mm long. No mature flowers of *M. ecuadorensis* have yet been seen.

Paratypes. ECUADOR. **Napo [Orellana]:** Parque Nacional Yasuní, pozo petrolero Daimi 2, *C. Cerón & Hurtado 3922* (MO); pozo petrolero AMO II de Conoco, *F. Coello 19* (MO); Yasuní National Park, Pontificia Universidad Católica del Ecuador Scientific Research Station by Tiputini River, along Perú trail, *C. Persson 554* (MO); Estación Científica Yasuní, Río Tiputini, al SO de la confluencia con el Río Tivacuno, 6 km al E de la carretera Maxus, Km 44, desvio hacia el pozo Tivacuno, *K. Romoleroux & Pitman 2326* (MO). **Sucumbíos:** Finca Cielito Lindo, *X. Cornejo 7552* (GUAY, MO).

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Rubiacearum Americanarum Magna Hama Pars XV. New Species and Two New Combinations in *Notopleura* (Psychotrieae) from Central and South America

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Abstract. *Notopleura* (Bentham & Hooker f.) Bremekamp is a Neotropical genus of about 100 species that was formerly included in *Psychotria*, but differs from that in its low succulent habit, stipules with a single usually glandular interpetiolar appendage, and terminal or often pseudoaxillary inflorescences. *Notopleura* is widely distributed in wet habitats and includes two subgenera: subgenus *Notopleura*, which comprises terrestrial, usually unbranched plants and includes most of the species in the genus, and subgenus *Viscogoga*, which comprises epiphytic, usually branched plants. In subgenus *Notopleura* here the new combination *N. madida* (Standley) C. M. Taylor is made based on *Psychotria madida* Standley of Ecuador, and 21 new species are described and illustrated: *N. amicitiae* C. M. Taylor of eastern Costa Rica and western Panama, which has been confused with *N. aggregata* (Standley) C. M. Taylor; *N. biloba* C. M. Taylor of northwestern Colombia, which has been confused with *N. macropodantha* (Standley) C. M. Taylor; *N. bryophila* C. M. Taylor of montane Ecuador, which has been confused with *N. marginata* (Bentham) Bullock; *N. capitata* C. M. Taylor, found from Nicaragua to Panama and previously confused with *N. aggregata*; *N. corniculata* C. M. Taylor of western Colombia and Ecuador, which has been confused with *N. anomothyrsa* (K. Schumann & Donnell Smith) C. M. Taylor; *N. corymbosa* C. M. Taylor of Ecuador, which has been confused with *N. micayensis* (Standley) Bremekamp; *N. costaricensis* C. M. Taylor of montane Costa Rica, which has been confused with *N. aggregata*; *N. hurtadoi* C. M. Taylor of Ecuador, which has been confused with *N. leucantha* (K. Krause) C. M. Taylor; *N. hypolaevis* C. M. Taylor of Ecuador, which has been confused with *N. uliginosa* (Swartz) Bremekamp; *N. longiflora* C. M. Taylor of northwestern Colombia, which has been confused with *N. macropodantha*; *N. montana* C. M. Taylor of montane Costa Rica to Venezuela and Peru, which has been confused with *N. macrophylla* (Ruiz & Pavón) C. M. Taylor; *N. multinervia* C. M. Taylor of montane western Panama, which has been confused with *N. aggregata*; *N. obtusa* C. M. Taylor of Ecuador and northern Peru, which has been confused with *N. aequatoriana* C. M. Taylor; *N. pacorana* C. M. Taylor of central Panama, which has been confused with *N. panamensis* (Dwyer) C. M. Taylor; *N. parvifolia* C. M. Taylor of western Panama, which has been confused with *N. aggregata*; *N. penduliflora* C. M. Taylor of western Panama, which has been confused with *N. plagiantha* (Standley) C. M. Taylor; *N. sanblasensis* C. M. Taylor of central Panama, which has also been confused with *N. panamensis*; *N. spiciformis* C. M. Taylor of western Colombia and Ecuador, which has been confused with *N. longipedunculoides* (C. M. Taylor) C. M. Taylor; *N. torrana* C. M. Taylor of western Panama, which has been confused with *N. macropodantha*; *N. tubulistipula* C. M. Taylor of Ecuador, which has again been confused with *N. aggregata*; and *N. zarucchiana* C. M. Taylor of montane Colombia, which has also been confused with *N. macropodantha*. Also in subgenus *Notopleura*, the correct names and their authorship are discussed for the species *N. longipedunculoides* (the formal new combination made here), *N. longissima* Bremekamp, and *N. micayensis*. In subgenus *Viscagoga* five new species are described and illustrated: *N. bahiensis* C. M. Taylor, which is similar to *N. multiramosa* (Steyermark) C. M. Taylor; *N. cocleensis* C. M. Taylor from western Panama, which has been confused with *N. guadalupensis* (DC.) C. M. Taylor; *N. elegans* C. M. Taylor from Costa Rica and western Panama, which has also been confused with *N. guadalupensis*; *N. episcandens* C. M. Taylor & Lorence from eastern Panama, which has been confused with *N. maxonii* (Standley) C. M. Taylor; and *N. vargasiana* C. M. Taylor from Ecuador, which again has been confused with *N. guadalupensis*.

Key words: Neotropics, *Notopleura*, Psychotrieae, Rubiaceae.

The genus *Notopleura* (Bentham & Hooker f.)

Bremekamp comprises a group of about 100 species of succulent Neotropical herbs and subshrubs that were previously included in *Psychotria* subg. *Heteropsychotria* Steyermark (Taylor, 2001a). *Notopleura* is distinguished by its herbaceous or suffrutescent, succulent habit; its stipules that are united around the stem into a reduced to well-developed sheath with a single, usually glandular, interpetiolar appendage of varied form that is inserted below the top of that sheath; its inflorescences that are terminal or pseudoaxillary; its corollas with valvate aestivation; and its succulent drupaceous fruits with 2 to 6 pyrenes. Additionally, its pyrenes have a unique pattern of dehiscence, with two long marginal slits and often also one shorter medial ventral slit (Piesschaert, 2001). The term "pseudoaxillary" is used here to designate inflorescences produced in a terminal position developmentally on a stem that grows sympodially, from an apparently axillary bud, so the inflorescence is found in only one axil at each node. This inflorescence position is sometimes called lateral or axillary, and is considered by some other workers to represent an axillary inflorescence arrangement with the consistent suppression of the inflorescence in one axil at each node. No conclusive evidence has been offered to support either interpretation. If the pseudoaxillary inflorescences of *Notopleura* are in fact truly axillary with a consistent asymmetric suppression of growth, this inflorescence arrangement would be very different from the terminal and sometimes overtopped, apparently lateral inflorescences that are also found in this genus, rather than easily derived from it. In either case the pseudoaxillary inflorescence arrangement is distinctive and easily seen on the plants.

Notopleura was first separated from *Psychotria* L. by Bremekamp (1934) in his work on the Rubiaceae of Surinam. Bremekamp here recognized a number of small genera instead of a comprehensive *Psychotria*, and his views on this group were not adopted by subsequent authors working on the Neotropical flora. *Notopleura* has only recently been separated from *Psychotria* in its current circumscription, with its position supported by molecular (Nepokroeff et al., 1999; Andersson & Rova, 1999) and morphological (Taylor, 1996) data. An overview of the morphology of the genus, its separation into two subgenera, and a key to its then 73 species were presented by Taylor (2001a), with 18 species newly described there. Subgenus *Notopleura* comprises terrestrial, usually unbranched plants and includes most of the species in the genus; subgenus *Viscogoga* (Baillon) C. M. Taylor comprises epiphytic, usually branched plants. Both of these are found generally throughout the range of the genus.

The present article results from study of *Notopleura* for several projects, including *Flora Mesoamericana* and the *Flora of Ecuador*, and adds to *Notopleura* one previously described species (i.e., a new combination) and 26 newly described species from eight countries. Additionally, several of the combinations published by Taylor (2001a) were inaccurate and are here corrected. The species discussed below are organized by subgenus, and within each subgenus the species are arranged alphabetically. The figures group together species that are similar morphologically to each other.

The proportion of newly described species of *Notopleura*, 44 of 100 species including those described here and by Taylor (2001a; Appendix 1), is relatively high even among Neotropical Rubiaceae. *Notopleura* has been poorly known scientifically due to its concentration of species in wet premontane forests, which are not well explored; its generally low herbaceous habit, which excludes it from many floristic studies that focus on woody plants; its succulent tissues, which do not preserve well in dried specimens; and its often unbranched habit, which means usually only one or two fertile specimens can be made from a single plant so if the plants are rare, little material is collected.

Species Groups

No classification below the level of subgenus has yet been proposed for *Notopleura*, although there appear to be several well-marked species groups within subgenus *Notopleura*. Some of these are outlined below; no doubt further study will reveal additional groups.

The *Notopleura siggersiana* group

One well-marked group of similar species is the "*Notopleura siggersiana* group," which is characterized by fruits that are red at maturity and pyrenes that are smooth on the dorsal (i.e., abaxial) surface. Additionally, dried specimens of the species in this group often have a clear green color and a distinctive pattern of the higher-order venation, with numerous short intersecondary veins usually clearly evident at least on the lower leaf surfaces. As in other Psychotrieae, there is marked variation in the inflorescences in this group from capitate (e.g., *N. pyramidata* C. M. Taylor) to lax and branched to several orders (e.g., *N. pilosula* C. M. Taylor). This group is found from southern Mexico to Bolivia and includes *N. siggersiana* (Standley) C. M. Taylor, *N. parasiggersiana* C. M. Taylor,

N. congesta C. M. Taylor, *N. hondurensis* C. M. Taylor, *N. palestinae* (Standley ex Steyermark) C. M. Taylor, *N. pilosula*, *N. pyramidata*, *N. scarlatina* C. M. Taylor, and *N. cundinamarcana* C. M. Taylor.

THE *NOTOPLEURA ULIGINOSA* GROUP

Another group of *Notopleura* species is characterized by pyrenes that are strongly dorsiventrally flattened and have their central dorsal ridge and margins markedly thickened. This "*Notopleura uliginosa* group" is also characterized by fruits that turn orange or red as they develop and then finally black at maturity, and also has leaves that are markedly discolorous and usually brown abaxially when dry. This group comprises *N. uliginosa*, *N. agostinii* (Steyermark) C. M. Taylor, *N. fernandezii* (Steyermark) C. M. Taylor, and *N. patria* (Steyermark) C. M. Taylor. These species are found in the central and northern mountains of Venezuela except for *N. uliginosa*, which is found from Mexico to the northern coast of South America and throughout the Antilles.

THE *NOTOPLEURA AGGREGATA* GROUP

The "*Notopleura aggregata* group" has pyrenes similar in form to those of *N. uliginosa*, but its fruits are white at maturity and its leaves usually are green when dry. This group includes *N. aggregata*, *N. tonduzii* (Standley) C. M. Taylor, and several species described in this article: *N. capitata*, *N. costaricensis*, *N. multinervia*, *N. parvifolia*, and *N. tubulistipula*. These species are all found in southern Central America and adjacent northwestern Colombia.

THE *NOTOPLEURA MACROPODANTHA* GROUP

Several *Notopleura* species from the Andes of Colombia share a relatively low habit, relatively small leaves, relatively well-developed calyx limbs, and pyrenes that are smooth dorsally. This "*Notopleura macropodantha* group" is most diverse in montane and premontane forests in the Cordillera Occidental, and known largely through the collections of the active botanists in Medellín and Cali, Colombia. This group includes *N. macropodantha*, *N. lanosa* C. M. Taylor, *N. biloba*, *N. longiflora*, *N. torrana*, and *N. zarucchiana* (the last four species are described in this article). Several of these species are notable for their leaf venation, with the secondary veins extending to unite with the margins, which are usually strongly thickened; several other species have the leaf margins thickened but the secondary veins not visible. Additionally, some of these species are notable for the pubescence on their adaxial leaf surfaces. These trichomes are developed and often arranged in small clusters. Inflorescence arrangement in this group varies widely, from densely capitate (e.g., *N. lanosa*) to laxly branched (e.g., *N. zarucchiana*). Stipule form also varies widely among species in this group: those of *N. lanosa* have a well-developed sheath without any interpetiolar appendage; those of *N. torrana*, *N. longiflora*, and *N. zarucchiana* have their interpetiolar portions narrowed and triangular, and in the latter two species also glandular; and the laminar stipules of *N. macropodantha* and *N. biloba* are deeply divided into two narrow, relatively long lobes. These last two stipule forms are not known in any other species of *Notopleura*.

Notopleura (Bentham & Hooker f.) Bremekamp, Rec. Trav. Bot. Néerl. 31: 289. 1934. *Psychotria* sect. *Notopleura* Bentham & Hooker f., Gen. Pl. 2: 124. 1874. TYPE: *Notopleura marginata* (Bentham) Bullock.

I. Notopleura subg. **Notopleura.**

This subgenus comprises 85 species (including the 21 newly described in this article), which are recognizable by their terrestrial, usually unbranched habit, pseudoaxillary inflorescences, and pyrenes two per fruit. Stipule form varies widely in this group; all the stipule forms known from *Notopleura* are found in this subgenus. Species of subgenus *Notopleura* are found generally throughout the range of the genus, except they are so far unknown in eastern Brazil.

I. 1. Notopleura amicitiae C. M. Taylor, sp. nov. TYPE: Panama. Chiriquí: Hartman [sic] finca, near Cerro Pando, 8°52′N, 82°45′W, 2000–2200 m, 22 Aug. 1982, *C. Hamilton, H. Stockwell & A. Aiello 855* (holotype, MO-3610955). Figure 1C, D.

Haec species a *Notopleura tolimensi* floribus in glomerulos multifloros densos dispositis, limbo calycino 1–1.2 mm longo atque appendicibus stipularibus interpetiolaribus cum foliis persistentibus distinguitur.

Succulent, erect, terrestrial herbs or soft shrubs to 2 m tall, unbranched; stems glabrous. *Leaves* narrowly elliptic to oblanceolate, 12–23.5 × 2.5–4.5 cm, at apex acute to somewhat acuminate, at base acute to attenuate, drying membranaceous to papyraceous, adaxially glabrous, abaxially glabrous or puberulous to glabrescent and often paler; secondary veins 10 to 15 pairs, weakly brochidodromous, adaxially venation plane, abaxially costa and sec-

ondary veins prominulous and remaining venation plane and invisible or usually intersecondaries and reticulated tertiary venation visible; margins plane; *petioles* 0.5–2.5 cm long; *stipules* glabrous, sheath 1–1.5 mm long, truncate to triangular, generally persisting with leaves, with interpetiolar appendage triangular to ovate, 3–4 mm long, inserted just above medially, generally persisting with leaves, somewhat flattened, acute to shortly bifid, marginally winged. *Inflorescences* pseudoaxillary, paniculate, densely puberulous, ascending, green; peduncles 1.5–7.5 cm long; branched portion pyramidal to rounded-corymbiform, 1.5–3.5 × 2–5 cm, with secondary axes developed at (1)2 nodes, 2 or 3 per node, usually branched to 1, 2, or more orders, axes terminating in floral glomerules; bracts narrowly triangular, acute, those subtending secondary axes 2–6 mm long, those subtending flowers 1.5–3 mm long; *flowers* sessile or subsessile in glomerules of 5 to 11; hypanthium turbinate, ca. 1 mm long, glabrous; *calyx limb* glabrous or puberulous, 1–1.2 mm long, 5-lobed for 1/4–1/3, lobes narrowly triangular; *corolla* funnelform, white, externally puberulous, internally glabrous except sparsely hirtellous near middle of tube, tube ca. 5 mm long, lobes 5, ca. 2 mm long, narrowly triangular, abaxially with a rounded appendage to 0.3 mm high; *anthers* in short-styled form ca. 1.5 mm long, exserted; *stigmas* 2, linear, in short-styled form ca. 1.5 mm long, situated just above middle of corolla tube. *Infructescences* similar to inflorescences; *fruits* globose, ca. 5 × 4 mm, white, glabrous, sessile; *pyrenes* 2, hemispherical in cross section, dorsally with 3 to 4 rounded longitudinal ridges.

Habitat, distribution, and phenology. In wet forest at 1300 to 2200 m, eastern Costa Rica and western Panama; collected in flower in February, March, May, July, August, and October, and in fruit often concurrently, August through October.

Notopleura amicitiae is distinguished by its relatively narrow leaves, its inflorescences with the flowers arranged in separated glomerules, its corolla lobes with short rounded abaxial appendages, and its pyrenes that are hemispherical in cross section and longitudinally 3- to 4-ridged. It is similar to *N. aggregata* and *N. tolimensis* (Wernham) C. M. Taylor; *N. aggregata* differs from *N. amicitiae* in its relatively broader leaves, 4–12.5 cm wide, its interpetiolar stipule appendages 4–11 mm long, its corolla lobes with abaxial appendages 0.5–1 mm long, and its pyrenes that are strongly dorsiventrally flattened; *N. tolimensis* differs from this new species in its flowers separated along the inflorescence axes individually or in glomerules of 2 to 5, its calyx limb 0.5–0.8 mm long, and its caducous interpetiolar stipule appendages. The specific epithet refers to the geographic distribution of this new species, in and around the binational Parque da la Amistad (i.e., Friendship Park). This new species is distylous, but the long-styled form is represented in the material studied only by flower buds, so measurements of these immature parts are not included in the description above.

Paratypes. COSTA RICA. **Puntarenas:** Cordillera de Talamanca, area around Río Canasta, 9.5 airline km [sic] NW of Agua Caliente, between Cerro Frantzius and Cerro Pittier, *Davidse et al. 28445* (MO); Coto Brus, Zona Protectora Las Tablas, Cuenca Térraba-Sierpe, Finca La Neblina, Finca de William Gamboa, *Gamboa 1129* (MO); upper Río Burú, *L. D. Gómez et al. 21749* (MO); Coto Brus, Reserva de la Biósfera de la Amistad, cerca Estación Biológica Las Alturas de Coton, *Kress & Prinzie 94–4588* (MO); Coto Brus, cuenca Térraba–Sierpe, pie Quijada Diablo, *E. Navarro V. 723* (MO). PANAMA. **Chiriquí:** near Costa Rican border, 13 km by road S of Río Sereno, Finca Hartmann, *Hensold 1019* (MO, PMA); headwaters of Río Chevo, Finca Ojo de Agua, *Knapp 1445* (MO); lower slopes of Cerro Pelota, *Knapp 1498* (MO); Santa Clara region, 27 km NW of El Hato del Volcán, on coffee finca of Rattibor Hartman [sic] called Ojo de Agua, *Mori & Bolten 7195* (MO); dtto. Bugaba, Santa Clara, Hartmann's Finca, *van der Werff & Herrera 7083* (MO, PMA), *7095* (MO).

I. 2. Notopleura biloba C. M. Taylor, sp. nov. TYPE: Colombia. Chocó: San José del Palmar, Cerro del Torrá, vertiente nororiental, abajo del helipuerto, 1860–1870 m, 5 Jan. 1984, *F. [sic; P.] A. Silverstone-Sopkin, N. Paz, A. Duque & H. Bayona 1540* (holotype, CUVC-10879; isotypes, COL-277624, CUVC-10880, MO-3250071, MO-4342380). Figure 2D, E.

Haec species a *Notopleura macropodantha* foliorum marginibus valde incrassatis venis secundariis non manifestis atque bracteis floralibus et limbo calycino bene evolutis, a *N. torrana* stipulis laminaribus in lobulos duos angustos bene evolutos desinentibus distinguitur.

Succulent, terrestrial or sometimes epiphytic, erect or sometimes clambering herbs; stems to 0.5 m long, densely hirtellous sometimes becoming glabrescent. *Leaves* lanceolate, 2.5–7.5 × 0.6–2.2 cm, at apex acute to acuminate, at base obtuse to cuneate, drying papyraceous, adaxially glabrous, abaxially drying paler and glabrous or sparsely hirtellous; secondary veins not visible, adaxially venation plane, abaxially costa prominulous and remaining venation invisible and plane; margins markedly thickened; *petioles* 2–6 mm long, densely hirtellous to glabrescent; *stipules* glabrous, laminar, persisting with leaves, unlobed basal portion broadly triangular, 2–3 mm long, terminating in 2 lobes

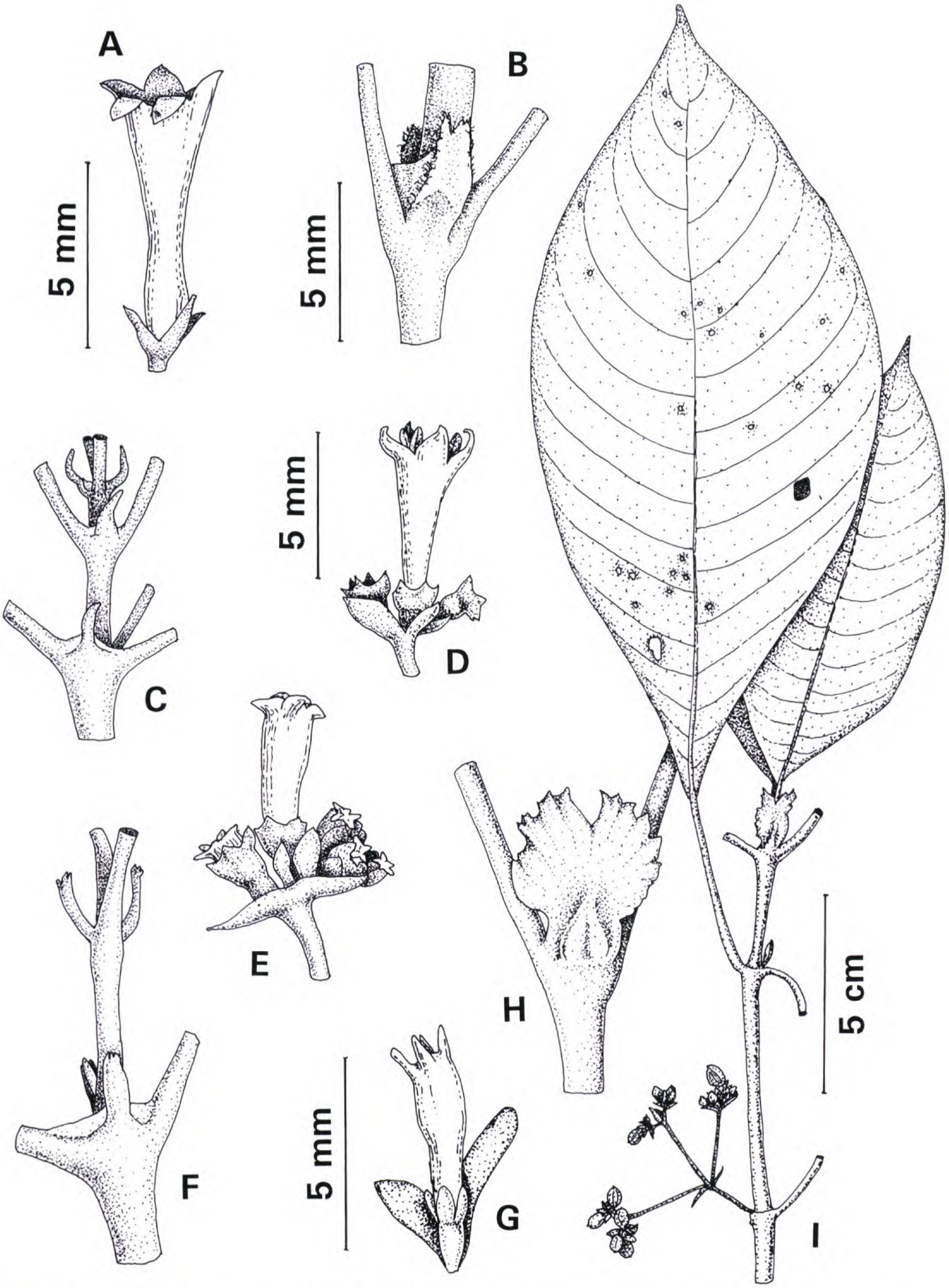

Figure 1. A, B, *Notopleura tubulistipula* C. M. Taylor, based on *Palacios et al. 2550* (MO). —A. Flower at anthesis. —B. Stem node with stipule and basal portions of petioles. C, D, *Notopleura amicitiae* C. M. Taylor, based on *Hensold 1019* (MO). —C. Stem portion with three nodes and basal portions of petioles. —D. Portion of inflorescence with a flower at anthesis and two older flowers from which the corollas have fallen. E, F, *Notopleura multinervia* C. M. Taylor. —E. Portion of inflorescence with one well-developed flower bud and three younger flower buds; based on *Croat & Grayum 60047* (MO). —F. Stem portion with two nodes with stipules and basal portions of petioles; based on *Knapp*

2–4 mm long, narrowly triangular to linear, closely set or sometimes fused for 1/3, persistent. *Inflorescences* pseudoaxillary, subcapitate to congested-cymose, hirtellous; peduncles 0.5–2.5 cm long; heads or cymes rounded-corymbiform, 8–10 × 10–25 mm, secondary axes absent or 1 pair; bracts narrowly triangular to lanceolate, 5–10 mm long, acute to acuminate, glabrous, entire; *flowers* not seen, reportedly white. *Fruits* narrowly ellipsoid, ca. 3.5 × 2.5 mm, glabrous, white, subsessile in glomerules to pedicellate in dichotomous cymules of 2 to 3, with pedicels to 2 mm long, with persistent calyx limb 3–4 mm long, glabrous, lobed nearly to base, lobes 5, narrowly triangular, acute to acuminate, entire; *pyrenes* 2, hemispherical in cross section, dorsally smooth.

Habitat, distribution, and phenology. In wet forest at 1630 to 2140 m, west-central Colombia; collected in fruit in January and August.

Notopleura biloba is distinguished by its leaves with the margins markedly thickened and the secondary veins and higher-order venation not visible, its persistent laminar stipules with two well-developed narrow lobes, its subcapitate to congested-cymose, corymbiform inflorescences, its well-developed bracts and calyx lobes, and its relatively small narrow pyrenes. The specific epithet refers to the stipule morphology, which is unusual in *Notopleura* but similar to that of *N. macropodantha*. *Notopleura biloba* is similar in general aspect to both *N. macropodantha* and *N. torrana*; *N. macropodantha* differs from *N. biloba* in its leaves with the secondary veins visible on the lower (i.e., abaxial) surface, calyx limb ca. 2 mm long, and range in the northern Cordillera Oriental of Colombia, while *N. torrana* differs from this new species in its leaves drying chartaceous, its stipules that have a triangular sheath with a succulent conical appendage inserted near the middle of the sheath, its capitate inflorescences, and its calyx limb 2–2.5 mm long. *Notopleura biloba* and *N. torrana* are sympatric and apparently closely related to each other. *Notopleura biloba* is included in the "*Notopleura macropodantha* group" discussed in the introductory portion of this article.

Paratypes. COLOMBIA. **Chocó:** San José del Palmar, El Corcovado, finca Ayaconas, *Franco et al. 1601* (COL, MO); San José del Palmar, Río Negro, Cerro del Torrá, vertiente oriental del Río Negro, abajo del helipuerto, *J. E. Ramos et al. 1060* (CUVC, MO); Cerro del Torrá, vertiente nordeste, abajo de pista de helicópteros, *Silverstone[-Sopkin] 1338* (COL, CUVC); Cerro del Torrá, vertiente nororiental, *Silverstone-Sopkin et al. 1717* (COL, CUVC).

I. 3. Notopleura bryophila C. M. Taylor, sp. nov. TYPE: Ecuador. Loja: Cogradia, Saraguro–Loja, Km 40.2, 3°49′S, 79°18′W, 2580 m, 9 Dec. 1994, *P. M. Jørgensen, C. Ulloa, H. Vargas & P. Lozano 1380* (holotype, QCNE; isotype, MO-5006169). Figure 3D, E.

Haec species a *Notopleura marginata* stipularum vagina bene evoluta appendicem interpetiolarem succulentam conicam gerente, pedunculo 0.5–5.5 cm longo internodium caulinum non excedente atque pyrenarum marginibus et porcis dorsalibus tribus acutis distinguitur.

Erect, terrestrial, succulent herbs or soft shrubs to 1 m tall, unbranched; stems glabrous. *Leaves* elliptic to elliptic-oblong or ovate, 9–17.5 × 4–7.5 cm, at apex acute to somewhat acuminate, at base cuneate to obtuse, drying membranaceous to papyraceous, adaxially puberulous to glabrescent, abaxially concolorous and densely puberulous; secondary veins 11 to 13 pairs, looping to interconnect, submarginal veins well marked and very close to margins, adaxially venation plane, abaxially costa prominent, secondary veins prominulous, and remaining venation plane and not at all visible or often intersecondary veins developed and visible; margins plane, entire; *petioles* 0.8–4.5 cm long, puberulous to glabrescent; *stipules* glabrous, sheath truncate to rounded, 1.5–2 mm long, persistent on distalmost 2 to 3 nodes, with interpetiolar appendage inserted above medially, conical, 1–3 mm long, succulent, divergent, entire to shortly bifid, caducous. *Inflorescences* pseudoaxillary, ascending, paniculate, green, densely puberulous to hirtellous; peduncles 0.5–5.5 cm long, shorter than or equal to the next stem internode; branched portion rounded-corymbiform, 1.5–4 × 1.6–6.5 cm, with 1 to 2 pairs of secondary axes, these 2 per node, dichasially branched; bracts triangular to ovate or lanceolate, acute, entire, those subtending secondary axes 2–4 mm long, those subtending flowers 1–2 mm long; *flowers* subsessile in loose glomerules of 2 to 5; hypanthium cylindrical, ca. 1 mm long, glabrous to densely puberulous; *calyx limb* densely puberulous, 1–1.2 mm long, 5-lobed for 1/4–1/2, lobes triangular, entire; *corolla* slenderly funnel-

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& Vodicka 5612 (MO). G–I, *Notopleura costaricensis* C. M. Taylor. —G. Flower bud with two bracts; based on *Lawton 995* (F). —H. Stem node with stipule and basal portions of petioles; based on *Dryer 191* (F). —I. Stem with leaves and infructescence; based on *Burger & Baker 9704* (F). C, F, H to same scale as B; E to same scale as D.

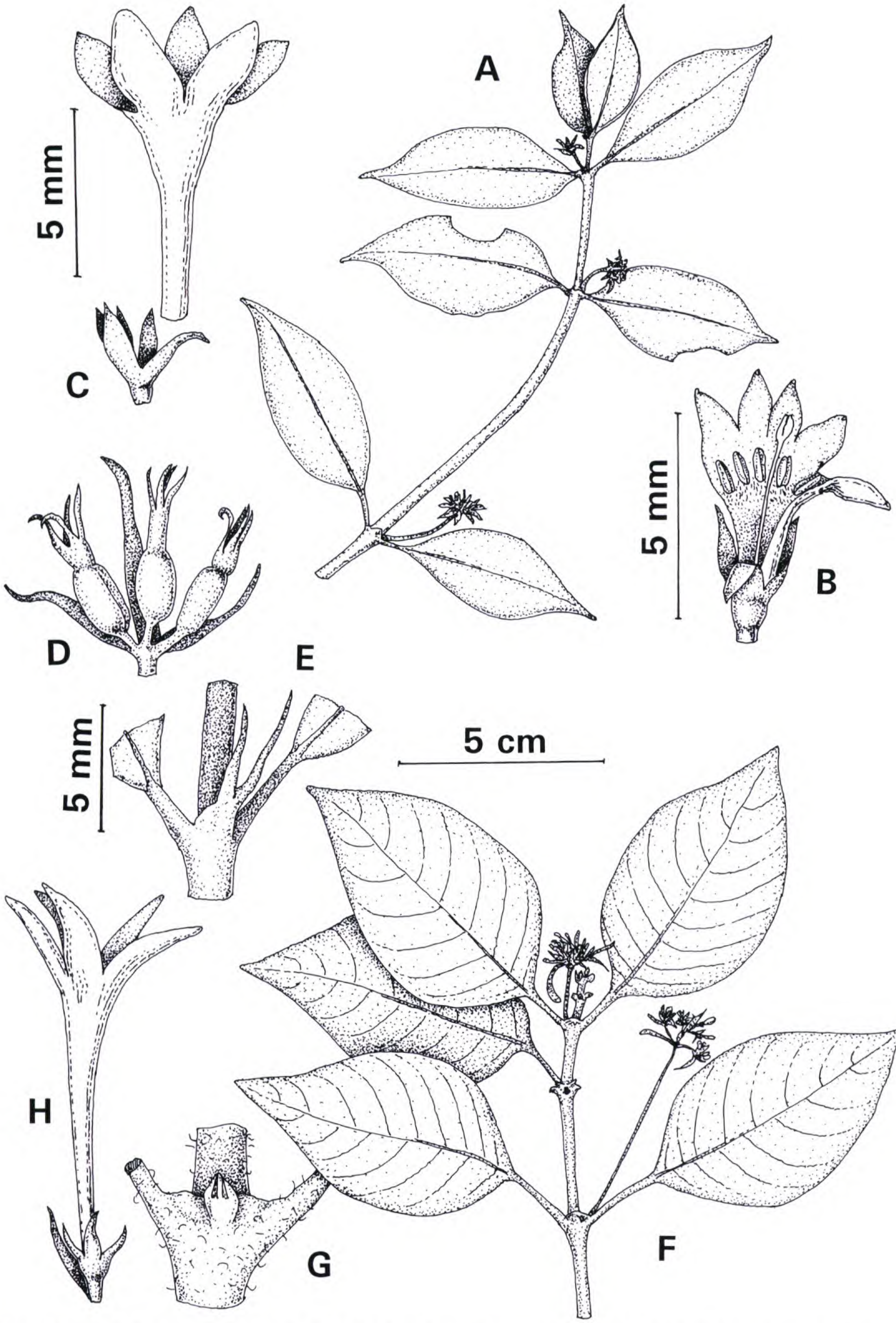

Figure 2. A, B, *Notopleura torrana* C. M. Taylor, based on *Silverstone-Sopkin et al. 4395* (MO). —A. Stem with leaves and inflorescences. —B. Flower at anthesis, partially dissected. —C. *Notopleura longiflora* C. M. Taylor, flower at anthesis, partially dissected; based on *Rodriguez & Giraldo 698* (JAUM). D, E, *Notopleura biloba* C. M. Taylor, based

form, yellow in bud apparently becoming white at anthesis, externally glabrous to puberulous, internally apparently glabrous, tube 5–6 mm long, lobes 5, 1–2 mm long, triangular, dorsally smooth; *anthers* ca. 0.8 mm long, situated near middle of tube; *stigmas* 2, ca. 0.8 mm long, situated in corolla throat. *Infructescences* similar to inflorescences or occasionally with axes becoming monochasial and elongated; *fruits* ellipsoid, 6 × 5–5.5 mm, white or possibly blue, glabrous, subsessile; *pyrenes* 2, in cross section hemispherical, dorsally with three sharp longitudinal ridges and margins sharp and divergent.

Habitat, distribution, and phenology. In montane wet forest at 2500 to 3200 m, central to southern Ecuador; collected in flower and fruit in July and September though December.

Notopleura bryophila is distinguished by its relatively small leaves, stipules with a well-developed sheath bearing a conical, succulent, interpetiolar appendage, peduncles 0.5–5.5 cm long and nearly always equal to or shorter than the accompanying distal stem internode, rounded-corymbiform inflorescences, and pyrenes with three sharp dorsal ridges and the margins acute. The species epithet refers to the habitat of this species, in high, wet, cloudy forest and also honors bryologist Robert E. Magill, a native of Texas and director of the Division of Research of the Missouri Botanical Garden, who greatly facilitated this work on *Notopleura*. *Notopleura bryophila* is similar to *N. marginata* (Bentham) Bullock (= *Psychotria hartwegiana* Standley); *N. marginata* differs from *N. bryophila* in its leaf margins that are plane to often crisped, stipules with a rounded erose interpetiolar lamina, peduncles 3.5–10 cm long and nearly always markedly longer than the accompanying distal stem internode, corollas that are orange or yellow in bud becoming yellow throughout or sometimes white on the tube at anthesis, and pyrenes that are dorsiventrally flattened with the margins rounded and dorsally smooth or with one or rarely three low rounded longitudinal ridges. These are the only two species of *Notopleura* for which flower colors other than white have been regularly noted. The fruits are described as white on all but one collection: the label of *Wiggins 11034* describes them as "china blue." A very few other Neotropical Rubiaceae species do have fruits that may be white or blue, with each color borne on a different plant [e.g., *Gonzalagunia spicata* (Lamarck) Gómez, Puerto Rico, Liogier, 1997, pers. obs.].

Paratypes. ECUADOR. **Azuay:** Sevilla de Oro, *Harling 1365* (S). **Bolívar:** Urcu-corral, Chillanes, *Acosta S. 6606* (F); ca. 10 km S of Chillanes, *Larsen et al. 45493* (AAU); West Cordillera above Balsapampa, *Rimbach 243* (F); Western Cordillera between Chimbo and Balsapampa, *Rimbach 582* (S). **Carchi:** high ridge across Río La Plata from Tambo La Palma, *Steere 8094* (F). **Chimborazo:** Pallatanga, comunidad Jesús del Gran Poder, from Panza Redonda on main highway, 2 km S on cobble road, ca. 4 km NE of Pallatanga, *J. L. Clark et al. 1390* (MO, QCNE); Pagma, *Wiggins 11034* (F, US). **Imbabura:** Cordillera Occidental, Azabí, *Acosta S. 14683* (F); Cotacachi, Tablachupa, Apuela, Finca de Jorge Vaca, *E. Gudiño & Cuamacás 1952* (MO); Cotacachi–Apuela road, Hacienda Tablachupa, *P. M. Jørgensen 61608* (AAU); Fila de Moinala, above Río Asabí, *Steere 8192* (F). **Pichincha:** Reserva Geobotánica Pululahua, camino a Lulumbamba, *C. E. Cerón 2565* (MO); in Pichincha prope Verdecocha, *Sodiro 84/33* [B destroyed, photo (Rockefeller neg. #475) F, MO]; Bosque Protector Pasochoa, 30 km SO de Quito, *J. F. Naranjo O. 58* (MO); Quito, Hacienda Tanlahua, 10 km N de San Antonio de Pichincha, Loma Monte Redondo, *H. Vargas et al. 254* (MO, QCNE). **Zamora–Chinchipe:** Campanas, al E de El Pan, Cordillera Oriental, *Acosta S. 5018* (F); Parque Nacional "Podocarpus," around pass on road Loja–Zamora, *Madsen 86974* (AAU); Km 16, road Loja–Zamora, *Sparre 16501* (S).

I. 4. Notopleura capitata C. M. Taylor, sp. nov. TYPE: Costa Rica. Heredia: Finca La Selva, the OTS field station on the Río Puerto Viejo just E of its junction with the Río Sarapiquí, common in cacao forest along West River Road, ca. 100 m, 8 Apr. 1982, *B. Hammel 11624* (holotype, MO-3222891; isotype, DUKE). Figure 4E, F.

Haec species a congeneris appendicibus stipularibus divergentibus conicis succulentis, inflorescentia capitata sessili subsessilive, limbo calycino 1.5–2.5 mm longo, lobulis corollinis dorsaliter laevibus vel incrassationem usque ad 0.5 mm longam gerentibus, fructu albo atque pyrenarum valde dorsiventraliter complanatarum carina marginibusque valde incrassatis distinguitur.

Succulent, terrestrial, erect herbs or soft shrubs to 3 m tall, unbranched; stems glabrous or puberulous becoming glabrescent. *Leaves* elliptic to obovate, 16–35 × 5.5–16 cm, at apex acute to shortly acuminate, at base acute to obtuse, drying papyraceous to membranaceous, adaxially glabrous,

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on *Silverstone-Sopkin et al. 1714* (MO). —D. Portion of inflorescence with three dry fruits. —E. Stem node with stipule and basal portions of leaves. F–H, *Notopleura zarucchiana* C. M. Taylor. —F. Stem with leaves and two inflorescences; based on *Callejas & Roldán 10511* (MO). —G. Stem node with stipule and basal portions of petioles; based on *Callejas et al. 6311* (HUA). —H. Flower at anthesis; based on *Callejas et al. 6311* (HUA). D, E, G, H to same scale.

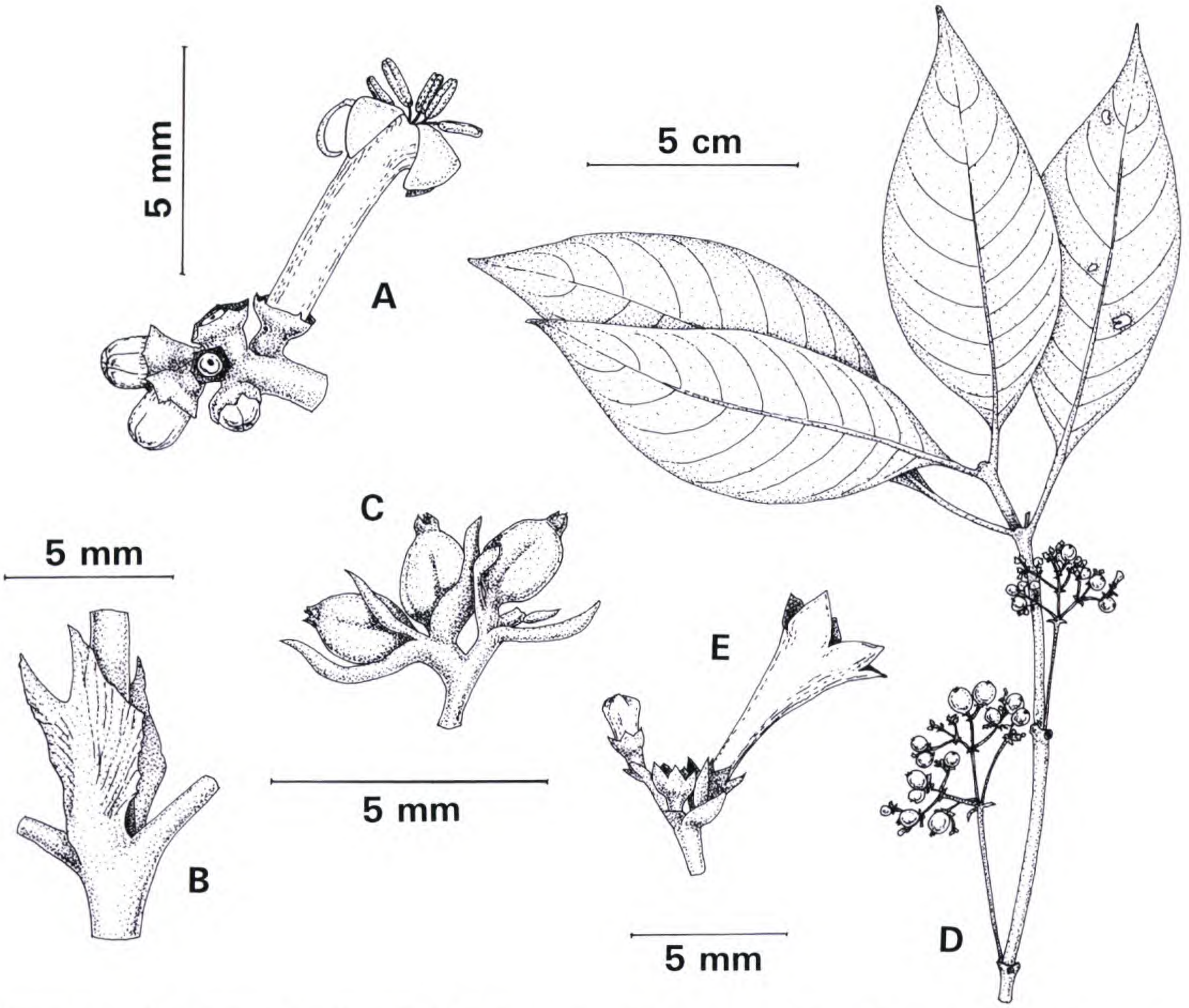

Figure 3. —A. *Notopleura hypolaevis* C. M. Taylor, portion of inflorescence with one flower at anthesis, three young flower buds, and two old flowers from which corollas have fallen; based on *Ståhl et al. 2907* (GB). B, C, *Notopleura corymbosa* C. M. Taylor. —B. Stem node with stipule and basal portions of petioles; based on *Smith & Dunn 3428* (MO). —C. Portion of infructescence with three dry fruits; based on *Øllgaard et al. 35706* (AAU). D, E, *Notopleura bryophila* C. M. Taylor. —D. Stem with leaves and infructescences; based on *Jørgensen et al. 1380* (MO). —E. Portion of inflorescence with one flower at anthesis, one young flower bud, and one old flower from which the corolla has fallen; based on *Gudiño & Cuamacás 1952* (MO).

abaxially paler and glabrous or puberulous becoming glabrescent; secondary veins 10 to 17 pairs, not looping to interconnect or often doing so near apex, adaxially costa plane or prominulous and remaining venation plane, costa and secondary veins often whitened, abaxially costa prominent, secondary veins prominulous, and remaining venation plane and invisible; *petioles* 1.5–6.5 cm long, glabrous or densely puberulous to glabrescent; *stipules* glabrous, united around stem or to petioles into a sheath 1–3 mm long, rounded to truncate, generally persisting with leaves, with an interpetiolar appendage 3–4 mm long, medially inserted, conical, succulent, divergent, triangular, flattened, marginally winged with wings 0.5–1 mm wide, hyaline, entire. *Inflorescences* pseudoaxillary, capitate, green, ascending to deflexed, puberulous; peduncles 1–12 mm long; heads 1 per axil, subglobose, 1–2 cm diam.; bracts ovate to lanceolate or triangular, 2–7 mm long, acute to obtuse, entire; *flowers* sessile; hypanthium turbinate-cylindrical, ca. 0.8 mm long, glabrous; *calyx limb* glabrous to puberulous, 1.5–2.5 mm long, lobed for 2/3 to nearly completely, lobes 5, deltoid to narrowly triangular and acute, entire to ciliolate; *corolla* tubular to slenderly infundibuliform, white, externally glabrous to puberulous, internally glabrous except hirtellous at stamen insertion, tube ca. 5 mm long, lobes 5, ca. 2 mm long, narrowly triangular, dorsally smooth or with 1 linear to conical appendage to 0.5 mm long; *anthers* ca. 1 mm long, positioned in upper part of corolla tube, included; *stigmas* 2,

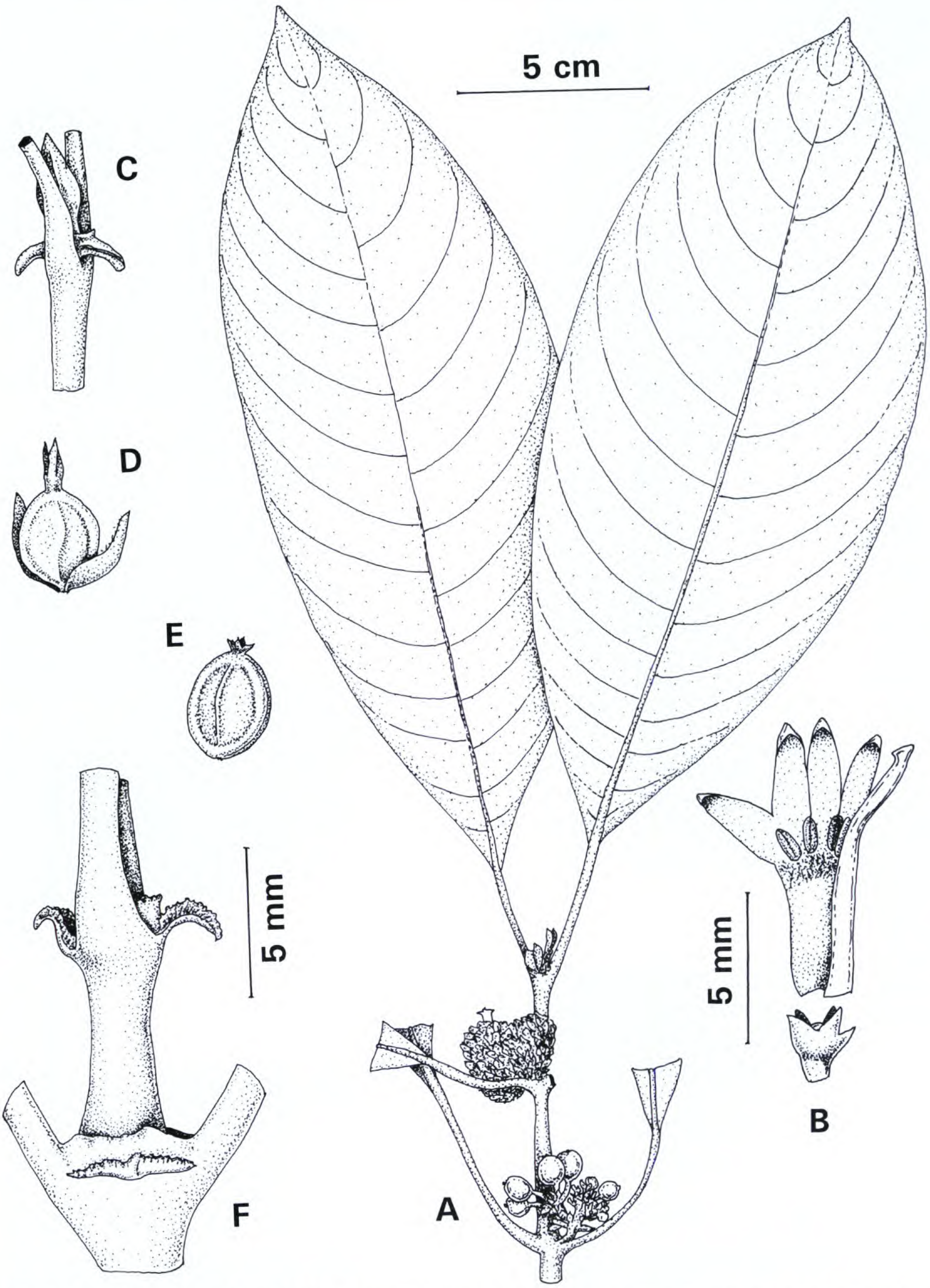

Figure 4. A, B, *Notopleura hurtadoi* C. M. Taylor. —A. Stem with leaves, inflorescences, and infructescences; based on *Hurtado & Alvarado 2132* (MO). —B. Flower at anthesis, partially dissected; based on *Alvarado 5* (MO). C, D, *Notopleura sanblasensis* C. M. Taylor, based on *Herrera & González 1334* (MO). —C. Stem node with stipule and basal portions of petioles. —D. Dry fruit with two bracts. E, F, *Notopleura capitata* C. M. Taylor. —E. Dry fruit; based on *Davidse 24332* (MO). —F. Stem portion with two nodes with stipules and basal portions of petioles; based on *Hammel 11624* (MO). C, D, E, F to same scale.

linear, exserted. *Infructescences* similar to inflorescences or becoming laxer, 6–10 cm diam., occasionally to rounded-corymbiform with axes developed at least shortly; *fruits* ellipsoid, 5–6 × 4.5–5 mm, white, glabrous, sometimes with stipes to 1 mm long; *pyrenes* 2, strongly dorsiventrally flattened, dorsally with 1 thickened central ridge and markedly thickened margins.

Habitat, distribution, and phenology. In wet forest at 10 to 1700 m on Caribbean slopes from Nicaragua to eastern Panama, and sometimes extending over the Continental Divide to the western mountain slopes; collected in flower February through July and October, in fruit in February, April, June through August, and October.

Notopleura capitata is distinguished by its combination of stipules with succulent, conical, divergent appendages, capitate sessile or subsessile inflorescences, calyx limbs 1.5–2.5 mm long, corollas with the lobes dorsally smooth or with a thickening to 0.5 mm long, white fruits, and strongly dorsiventrally flattened pyrenes with the keel and margins markedly thickened. The species epithet refers to the inflorescence arrangement. In some plants the infructescences later expand markedly, with the internodes of the axes becoming as much as 5 mm long between each fruit (e.g., *MacDougal 1015*). This new species was included in the original circumscription of *N. tonduzii* by Standey, and more recently has been included in the circumscription of *N. aggregata* by Dwyer (1980), Burger and Taylor (1993), and Taylor (1991, 2001a, 2001b). However, with closer study the capitate inflorescence arrangement can be seen to be correlated with other characters such as the calyx length, and these features do not intergrade with any other species of *Notopleura*. *Notopleura aggregata* and *N. tonduzii* both differ from *N. capitata* in their inflorescences with clearly developed, branching axes (i.e., while in flower). Also similar to *N. capitata* is *N. panamensis*; *N. panamensis* differs from *N. capitata* in its longer calyx lobes, 3.5–4.5 mm long, and its corolla lobes with linear dorsal appendages 3–4 mm long. *Notopleura capitata* is also similar to *N. pacorana* and *N. sanblasensis*, both described later in this article; the distinctions between *N. capitata* and these last species are discussed under their respective treatments. *Notopleura capitata* is included in the "*Notopleura aggregata* group" discussed in the introductory part of this article.

Although the flowers studied were not adequately preserved for confirmation of this aspect, Beach noted for two collections from La Selva (*Beach 1348, 1349*) that this species is distylous.

Paratypes. COSTA RICA. **Alajuela:** San Carlos, Peñas Blancas, *Haber & Bello 1941* (MO); 15 km NNW of San Ramón by road, 2.5 km N of Balsa on road to San Lorenzo, *Liesner & Judziewicz 14742* (MO); 13 km W of Fortuna on road to the Arenal Dam, near crossing of Río Tabacón, *Liesner et al. 15242* (MO). **Cartago:** Tapantí Hydroelectric Reserve along Río Dos Amigos, *Croat 36193* (MO); Tapantí Hydroelectric Project, 4–10 km beyond entrance to project, *Utley & Utley 5186* (MO). **Guanacaste:** Liberia, siguiendo el camino entre Nueva Zelandia (Quebrada Grande) y Dos Ríos Upala, San Gabriel, *G. Herrera et al. 2906* (MO). **Heredia:** Sarapiquí, zona protectora de San Carlos, Finca La Selva, the OTS biological Station on the Río Puerto Viejo just E of its junction with the Río Sarapiquí, near Puerto Viejo de Sarapiquí, *Beach 1348* (MO), *1349* (MO), *Faivre 12* (INB, MO), *Folsom 8727* (DUKE, MO), *Hammel 7933* (DUKE, MO), *Hammel & Trainer 13243* (DUKE, MO), *MacDougal 1015* (DUKE, MO), *McDowell 151* (DUKE, MO), *Opler 827* (MO). **Limón:** along Río Reventazón below farmhouse, Finca Castilla, *Dodge & Goerger 9404* (MO); Cerro Tortuguero, ladera NO, pendientes pronunciadas 4 km al N de Tortuguero, rumbo a la Barra del Colorado, *R. Robles 2122* (CR, MO). **Puntarenas:** foothills of the Cordillera de Talamanca, along Río Bella Vista, NW of Las Alturas, *Davidse 24332* (MO); Monte Verde [sic] area, valley of Río San Luis just S of Monte Verde, *Hammel & Haber 13919* (MO); Monteverde, Nuboso [trail], *Koptur SK-414* (MO). NICARAGUA. **Zelaya:** ca. 6.3 km S of bridge at Colonia Yolaina and ca. 0.8 km S of ridge Serranías de Yolaina on road to Colonia Manantiales (Colonia Somoza), *Stevens 6414* (MO). PANAMA. **Bocas del Toro:** along road between Gualaca and Chiriquí Grande, 6.6 mi. N of middle of bridge over Fortuna Lake, *Croat 66720* (MO, PMA); along oleoducto road between Continental Divide and Chiriquí Grande, *Hammel 13694* (MO); Cana–Cuasi Trail (Camp 2), Chepijana District, *Terry & Terry 1425* (MO). **San Blas:** trail from Río Esadi to Cerro Banega, *de Nevers & Herrera 6657* (MO, PMA).

I. 5. Notopleura corniculata C. M. Taylor, sp. nov. TYPE: Ecuador. Pichincha: road Santo Domingo–Quito, Cornejo Astorga (Tandapi), 1800 m, 7–10 May 1968, *G. Harling, G. Storm & B. Ström 9397* (holotype, GB; isotype, US). Figure 5A, B.

Haec species a *Notopleura anomothyrsa* lobulis corollinis appendices abaxiales triangulares vel anguste triangulares complanatas interdum alatas 1–2 mm longas gerentibus atque pyrenarum dorsiventraliter complanatarum carina centrali ac marginibus incrassatis distinguitur.

Succulent, terrestrial herbs or soft shrubs to 1.5 m tall, erect, unbranched; stems glabrous. *Leaves* elliptic to elliptic-oblong or elliptic-ovate, 11.5–30 × 5–12 cm, at apex acute or usually acuminate with a slender tip, at base acute to obtuse, drying papyraceous to membranaceous, adaxially glabrous, abaxially paler and densely puberulous to glabrescent; secondary veins 15 to 18 pairs, looping to interconnect in well-developed submarginal veins, adaxially venation plane, abaxially costa prominent, secondary veins prominulous, and high-

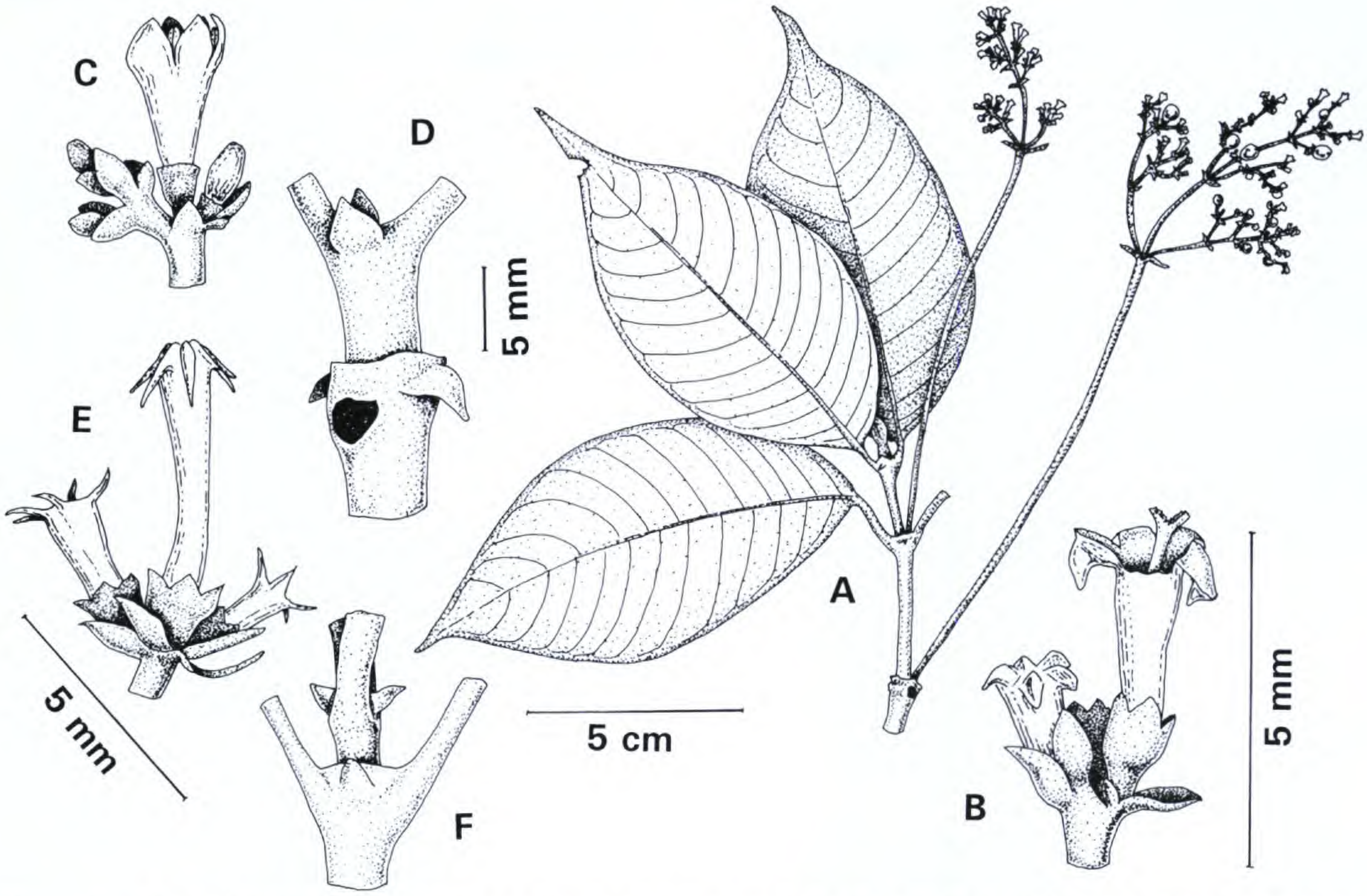

Figure 5. A, B, *Notopleura corniculata* C. M. Taylor, based on *Harling et al. 9397* (US). —A. Stem with leaves, inflorescence with only flowers, and inflorescence with flowers and developing fruits. —B. Portion of inflorescence with one flower at anthesis, one young flower bud, and (in back) one old flower from which the corolla has fallen. C, D, *Notopleura montana* C. M. Taylor; based on *Croat 50798* (MO). —C. Portion of inflorescence with one well-developed flower bud, with its lobes partially spread, and one younger flower bud. —D. Stem portion with two nodes and basal portions of petioles. E, F, *Notopleura spiciformis* C. M. Taylor, based on *van der Werff et al. 12081* (MO). —E. Portion of inflorescence with one well-developed flower bud and several younger buds. —F. Stem portion with two nodes and basal portions of petioles. C, E to same scale; D, F to same scale.

er-order venation plane and invisible or sometimes intersecondary veins visible; margins plane; *petioles* 1.5–5 cm long, glabrous to puberulous; *stipules* glabrous, with sheath 1–1.5 mm long, truncate, persistent on distalmost 2 to 3 nodes, with one interpetiolar appendage 2–2.5 mm long, medially inserted, conical, succulent, divergent, acute, caducous. *Inflorescences* pseudoaxillary, paniculate, green, ascending, densely puberulous to hirtellous; peduncles 7–18 cm long; branched portion cylindrical to narrowly pyramidal, 3.5–15 × 3–12 cm, branched to several degrees, with secondary axes produced at 3 to 4 nodes, 2 per node, with tertiary axes dichasially branched; bracts narrowly triangular, acute, entire, those subtending secondary axes 3–5 mm long, those subtending flowers 0.5–1.5 mm long; *flowers* sessile or subsessile in glomerules of 2 to 3; hypanthium turbinate to cylindrical, ca. 0.8 mm long, glabrous; *calyx limb* glabrous, 0.8–1 mm long, 5-lobed shallowly or for as much as 1/3 its length; *corolla* salverform, white, externally glabrous except sometimes puberulous on tube portion, internally glabrous except hirtellous at stamen attachment, tube 3–5 mm long, lobes 5, deltoid, 1–1.2 mm long, abaxially with an appendage 1–2 mm long, triangular to narrowly so, apparently flattened and winged; *anthers* in long-styled form ca. 1 mm long, included, situated above middle of corolla tube, in short-styled form not seen; *stigmas* 2, in long-styled form ca. 0.8 mm long and exserted, in short-styled form ca. 1.2 mm long, included, situated just above middle of corolla tube. *Infructescences* similar to inflorescences or with axes more expanded; *fruits* ellipsoid to orbicular, 4–6 × 4–6 mm, white, glabrous; *pyrenes* 2, markedly dorsiventrally flattened, dorsally with 1 central ridge, this sharp to flattened or furrowed (i.e., appearing as 2 closely set narrow central ridges), margins thickened, rounded to sharp.

Habitat, distribution, and phenology. In wet premontane and montane forests, Andean southern Colombia to central Ecuador at 1300 to 2200 m; collected in flower in February, March, May, July, October, and December, in fruit in February, May, and July.

Notopleura corniculata is similar in its general aspect to *N. anomothyrsa*, but *N. anomothyrsa* is distinguished from *N. corniculata* by its corolla lobes each with a conical, rounded, abaxial appendage ca. 0.5 mm long, peduncles 1.5–13 cm long, and pyrenes dorsally with 3 to 5 equally developed longitudinal ridges. The epithet of this new species refers to the appendages or "horns" on the corolla lobes, which are easily mistaken for the corolla lobes themselves. These structures are found in other Andean Rubiaceae (e.g., *Palicourea corniculata* C. M. Taylor, *P. cornigera* C. M. Taylor; Taylor, 1997), and their function is at present unknown. Occasional immature pyrenes have three evident longitudinal ridges, but the two lateral ridges diminish and eventually disappear as the pyrene matures.

Paratypes. COLOMBIA. **Nariño:** Ricaurte, Reserva Natural La Planada, bosque Santa Rosa, *C. Restrepo 572* (MO). ECUADOR. **Carchi:** Norte del Carmen, camino a Chical, *W. Palacios et al. 9782* (MO, QCNE). **Cotopaxi:** San Francisco de Las Pampas, Reserva La Otonga, Montaña Las Nubes, *Delprete et al. 6240* (NY). **Pichincha:** Quito, Chiriboga, en la carretera vieja Quito–Santo Domingo, Reserva Forestal La Favorita, cerca al Río Saloya, *C. E. Cerón et al. 7917* (MO), *Croat 72161* (MO); 1 km above Tandapi on Quito–Santo Domingo road, *Harling & Andersson 23238* (GB); road Chiriboga–Santo Domingo, Km 2, *Persson & Gustafsson 83* (GB), Km 15, *Persson & Gustafsson 98* (GB, MO); along road near Nanegal, *van der Werff et al. 12318* (MO).

I. 6. Notopleura corymbosa C. M. Taylor, sp. nov. TYPE: Ecuador. Zamora–Chinchipe: Zamora, Parque Nacional "Podocarpus," guardería en Río Bombuscaro, 970 m, 23 Jan. 1995, *W. Palacios & M. Tirado 13216* (holotype, QCNE; isotype, MO-5568184). Figure 3B, C.

Haec species a *Notopleura micayensi* stipulis laminaribus marginibus integris, limbo calycino 1–1.2 mm longo atque pyrenis marginibus laevibus vel leviter incrassatis distinguitur.

Erect, terrestrial, succulent herbs to 1.5 m tall, unbranched; stems glabrous. *Leaves* elliptic to obovate, 16–26 × 8–11 cm, at apex acute to usually shortly acuminate, at base cuneate to obtuse, drying papyraceous to membranaceous, adaxially glabrous, abaxially paler and puberulous to glabrescent; secondary veins 11 to 14 pairs, not looping to interconnect, adaxially venation plane, abaxially costa prominent, secondary veins prominulous, and remaining venation plane and invisible; margins plane; *petioles* 4–6 cm long; *stipules* glabrous, with sheath 0.5–2 mm long, truncate, persisting on distalmost 3 to 5 nodes, with interpetiolar appendage expanded, laminar, inserted near base of sheath or medially, elliptic to ovate, 6–20 mm long, caducous, drying papyraceous or chartaceous, bilobed for 1/3–1/2, lobes acute to rounded, sinus rounded, margins entire to a little irregular. *Inflorescences* and *flowers* not seen. *Infructescences* pseudoaxillary, usually borne with lower leaves, paniculate, purple, glabrous, ascending; peduncles 0.3–0.8 cm long; branched portion rounded-corymbiform, 2–3 × 5–5.5 cm, with developed secondary axes at 1 to 2 nodes, these 2 per node, branched to one or more additional orders, terminating in glomerules or cymules; bracts entire, acute, those subtending secondary axes lanceolate, 4–14 mm long, those subtending fruits linear to narrowly triangular, lanceolate, or narrowly elliptic, 5–6 mm long; *fruits* ellipsoid, ca. 5 × 3 mm, white, glabrous, sessile or subsessile in glomerules or dichasial cymules of 3 to 7, with persistent calyx limb 1–1.2 mm long, glabrescent, 5-lobed for 3/4 or more, lobes narrowly triangular, acute; *pyrenes* 2, dorsiventrally strongly flattened, dorsally smooth or with 1 rounded to sharp, central, longitudinal ridge, margins smooth to a little thickened and rounded.

Habitat, distribution, and phenology. In wet premontane forest at 970 to 1400 m in the eastern slopes of Ecuador; collected in fruit in January, April, and May.

Notopleura corymbosa is similar to *N. micayensis* and *N. thesceloantha* (Steyermark) C. M. Taylor in its expanded laminar stipules, short peduncles, inflorescences that are congested to subcapitate and have few secondary axes but well-developed bracts, white fruits, and pyrenes that are dorsiventrally flattened and dorsally have one central ridge. *Notopleura corymbosa* has been confused with both of these species previously; *N. micayensis* differs from *N. corymbosa* in its stipules that are strongly erose to fimbriate but not evidently bilobed or sometimes divided but only up to 1/4, its calyx limbs ca. 2 mm long, and its pyrenes with the margins markedly thickened; *N. thesceloantha* differs from *N. corymbosa* in its floral bracts 8–14 mm long, its calyx limbs ca. 4 mm long, and its distribution in lowland forests at 60–300 m in Ecuador. The specific epithet of this new species refers to the shape of the infructescences.

Paratypes. ECUADOR. **Pastaza:** Mera, *Harling 3142* (S); S of Shell-Mera, *Steere & Camp 8313* (F). **Sucumbíos:** road Baeza–Lago Agrio, *B. Øllgaard et al. 35706* (AAU); Salto San Rafael, along Río Quijos, *J. F. Smith & Dunn 3428* (MO); San Rafael, ca. 48 km NE of El Chaco, *Ståhl et al. 2433* (AAU, GB).

I. 7. Notopleura costaricensis C. M. Taylor, sp. nov. TYPE: Costa Rica. Puntarenas & Alajuela: in and around the Monteverde Nature reserve, mostly on the Pacific watershed, 10°18′N, 84°47′W, 1450–1640 m, 31 Oct. & 2 Nov. 1975, *W. Burger & R. Baker 9704* (holotype, F-1884792). Figure 1G–I.

Haec species a congeneris laminis stipularibus interpetiolaribus erosis bene evolutis, inflorescentiae axe secundario evoluto in florem desinente, bracteis floralibus bene evolutis, floribus sessilibus in glomerulos dispositis, limbo calycino 1.2–1.5 mm longo, lobulis corollinis appendices abaxiales lineares bene evolutas gerentibus, fructu albo atque pyrenis dorsaliter 4- vel 5-porcatis distinguitur.

Herbs or soft shrubs to 2 m tall, terrestrial, succulent, erect, unbranched; stems glabrous. *Leaves* elliptic, 13.5–23 × 6.5–10.5 cm, at apex acute to usually shortly acuminate, at base acute to cuneate, adaxially glabrous, abaxially pale and densely puberulous becoming glabrescent, drying membranaceous to papyraceous; secondary veins 14 to 19 pairs, looping to interconnect, adaxially venation plane or sometimes costa a little thickened, abaxially costa prominulous to prominent, secondary veins prominulous, and remaining venation plane and invisible or rarely intersecondary veins visible; margins plane; *petioles* 1.5–6 cm long, densely puberulous to glabrous; *stipules* glabrous, with sheath markedly reduced, with well-developed interpetiolar lamina inserted terminally on sheath, ovate to elliptic, 10–16 mm long, persistent on distalmost 2 to 3 nodes, erose to laciniate and often shortly bifid to bilobed for 1/3. *Inflorescences* pseudoaxillary, paniculate (often rather congested when young), green, puberulous to glabrescent; peduncles 0.5–4 cm long; branched portion rounded-corymibiform, 1.5–3 × 2–5 cm, with 1 to 2 pairs of secondary axes, these each terminating in 1 glomerule or less often 3 closely grouped glomerules; bracts elliptic to ovate or oblanceolate, 2–4 mm long, acute to obtuse or rounded, entire; *flowers* sessile in subglobose glomerules of 5 to 9; hypanthium turbinate, ca. 1 mm long, glabrous; *calyx limb* glabrous, 1.2–1.5 mm long, deeply 5-lobed, lobes ligulate or oblanceolate to lanceolate, obtuse, entire to ciliolate; *corolla* funnelform, white, externally and internally glabrous, tube ca. 4 mm long, lobes 5, ca. 1 mm long, with a linear abaxial appendage ca. 1 mm long; *anthers* not seen; *stigmas* 2, linear, 0.5–1 mm long, apparently situated in corolla throat. *Infructescences* similar to inflorescences; *fruits* ellipsoid to oblanceolate, ca. 5 × 3 mm, white, glabrous, with stipes to 1 mm long; *pyrenes* 2, dorsiventrally flattened, dorsally with 4 to 5 rounded longitudinal ridges, margins rounded.

Distribution, habitat, and phenology. In wet premontane and montane forest, in Tilarán and Talamanaca ranges in Costa Rica at 1000 to 2300 m; collected in flower in February, March, June, September, and December, in fruit in October and November.

Notopleura costaricensis is distinguished by its combination of stipules with well-developed erose laminas, inflorescences with the secondary axes developed and terminating in one to three glomerules of sessile flowers, well-developed bracts, calyx limbs 1.2–1.5 mm long, corolla lobes with well-developed, linear, abaxial appendages, white fruits, and pyrenes dorsally with 4 to 5 ridges. The specific epithet refers to its geographic distribution. It has previously been confused with *N. aggregata* and *N. tonduzii*, both of which are sympatric but have stipules with a well-developed sheath bearing a medial, conical, short appendage and pyrenes that dorsally have only one central ridge and the margins markedly thickened. *Notopleura costaricensis* has also been confused with *N. dukei* (Dwyer) C. M. Taylor, but *N. dukei* has 9 to 13 pairs of secondary leaf veins and peduncles 2.5–9 cm long. *Notopleura capitata* is included in the "*Notopleura aggregata* group" discussed in the introductory part of this article.

Paratypes. COSTA RICA. **Alajuela–Guanacaste–Puntarenas:** in and around the Monteverde Nature reserve, mostly on the Pacific watershed, *Lawton 995* (F). **Alajuela–Puntarenas:** Monteverde, Cordillera de Tilarán, *Dryer 191* (F). **Cartago:** mountains above Platanillo, *Wilbur & Stone 8647* (DUKE). **Puntarenas:** Monte Verde [sic] Reserve, along Sendero Nuboso, *Hammel 13860* (DUKE); Osa, Fila Costeña, Fila Cruces, cabeceras del Río Piedras Blancas, Cerro Anguciana, faldas al O, *Hammel et al. 19223* (F); above Wilson's Finca, 6 km S of San Vito de Java, *Raven 20894* (F), *21790* (F). **San José:** Pérez Seledón, Carretera Interamericana Km 115–116, *Hammel et al. 18051* (CR, F), Km 110, S of División, *Hammel & Hammel 18532* (INB, MO).

I. 8. Notopleura hurtadoi C. M. Taylor, sp. nov. TYPE: Ecuador. Napo: cantón Archidona, faldas al S del volcán Sumaco, carretera Hollín–Loreto, Km 50, comuna Huahua Sumaco, 00°43′S, 77°34′W, 18–21 May 1989, *F. Hurtado & A. Alvarado 2132* (holotype, MO-5017089). Figure 4A, B.

Haec species a *Notopleura leucantha* foliorum costa adaxialiter plana, bracteis floralibus obtusis usque rotundatis, limbo calycino 1–2 mm longo atque lobulis corollinis ca. 2.5 mm longis appendices dorsales conicas ca. 1.5 mm longas gerentibus distinguitur.

Terrestrial, succulent herbs or low shrubs to 1.5 m tall, unbranched or perhaps little-branched; stems glabrous. *Leaves* elliptic, 11–30 × 4.5–13 cm, at apex acute to usually shortly acuminate, at base cuneate to obtuse, drying papyraceous, adaxially glabrous, abaxially paler and glabrous; secondary veins 11 to 14 pairs, not looping to interconnect, adaxially venation plane, abaxially costa prominent, secondary veins prominulous, and higher-order venation invisible or tertiary venation visible and plane to thickened; *petioles* 2–7 cm long, glabrous; *stipules* glabrous, united around stem or to petioles into a sheath 1–2 mm long, broadly triangular, persistent on apical 3 to 4 nodes, with an interpetiolar appendage 1.5–2 mm long, stout, conical, succulent, divergent to recurved, inserted above medially, entire, glandular adaxially, caducous. *Inflorescences* pseudoaxillary, capitate, glabrous, ascending; peduncles 1 per axil, 1–10 mm long; heads 1 per peduncle, globose to weakly 3-lobed, 1–3 × 2–3 cm; bracts green, glabrous, entire, those external to inflorescence lanceolate to ovate, 6–10 mm long, acute, those subtending flowers oblanceolate, 5–8 mm long, obtuse to rounded, entire to ciliolate, usually falcate, usually hyaline in basal part and dark green in apical part; *flowers* sessile; hypanthium turbinate, ca. 1 mm long, glabrous; *calyx limb* glabrous, 1–2 mm long, lobed for ca. 1/2, lobes 5, irregularly deltoid to narrowly triangular and acuminate, usually unequal by 100% on a single flower, entire to a little erose; *corolla* white to cream, salverform, externally glabrous, internally glabrous except hirtellous at stamen insertion, tube ca. 6 mm long, lobes 5, ca. 2.5 mm long, narrowly triangular, dorsally with a stout conical appendage ca. 1.5 mm long, papillose to puberulous; *anthers* ca. 1.5 mm long, situated in corolla throat, included; *stigmas* 2, ca. 1.2 mm long, linear, situated with or just above anthers. *Infructescences* becoming more expanded than inflorescences, to 3 × 4 cm, sometimes with 1 pair of short secondary axes visible; *fruits* ovoid to ellipsoid, 6 × 5–6 mm, glabrous, red, with stipes to 5 mm long; *pyrenes* 2, strongly dorsiventrally flattened, with 1 sharp central ridge and margins somewhat thickened.

Habitat, distribution, and phenology. In wet forest at 580 to 1230 m on eastern Andean slopes in central and southern Ecuador; collected in flower in April, May, October, and November, in fruit in April, May, and October.

Notopleura hurtadoi is distinguished by its combination of stipules with an interpetiolar sheath bearing a medial conical appendage, capitate inflorescences, oblanceolate, rounded to obtuse floral bracts, corolla lobes with well-developed dorsal appendages, red fruits, and strongly dorsiventally flattened pyrenes. It is similar to *N. leucantha*; *N. leucantha* differs from *N. hurtadoi* in its leaves with the costa prominulous adaxially, acute floral bracts, calyx limb ca. 0.2 mm long, and corolla lobes ca. 1.5 mm long and smooth dorsally. Similarly to several species of *Notopleura*, *N. leucantha* has red fruits that become black at maturity and then are quickly removed by frugivores, and it is very possible that the mature fruits of *N. hurtadoi* are also black at maturity but have not yet been seen by collectors. The species epithet honors Fernando Hurtado, an Ecuadorian botanist working at QCNE who has contributed significantly to our knowledge of the Ecuadorian flora through his excellent plant specimens.

Paratypes. ECUADOR. **Morona–Santiago:** 2–4 km N of Arapicos, *H. Lugo S. 5944* (GB). **Napo:** Archidona, falda al S del volcán Sumaco, carretera Hollín–Loreto, Km 40, Huamaní, *A. Alvarado 5* (MO); Loreto, faldas del volcán Sumaco, al O de Avila Viejo, bloque 19, línea sísmica 8, Compañía Triton, *E. Freire & Cereda 98* (MO, QCNE); carretera Hollín–Loreto, Km 40–50, alrededores de la comunidad Huamaní y del Río Pucuno, *F. Hurtado 854* (MO); carretera Hollín–Loreto Km 25, centro Challuayacu, en trocha hacia la zona del Guagua Sumaco, *F. Hurtado & Alvarado 900* (MO); Archidona, carretera Hollín–Loreto Km 50, comunidad Huahua Sumaco, *F. Hurtado et al. 2017* (MO). **Pastaza:** Mera, *Asplund 18660* (S); 3.5 km N of Puyo, *Fagerlind & Wibom 1071* (S); pozo petrolero "Moretococha" de Arco, 75 km al E de Puyo, *E. Gudiño et al. 997* (MO, QCNE); Canelos, along path to Vera Cruz, *Harling 3255* (S).

I. 9. Notopleura hypolaevis C. M. Taylor, sp. nov. TYPE: Ecuador. Morona–Santiago: near Plan de Milagro on road to Indanza, 1650 m, 3°01′S, 78°29′W, 15 July 1996, *B. Ståhl & J. T. Knudsen 2877* (holotype, GB-182294). Figure 3A.

Haec species a *Notopleura uliginosa* foliorum venatione abaxialiter non manifesta, a *N. iridescente* inflorescentia pluriramosa distinguitur.

Terrestrial, erect, succulent herbs or soft shrubs to 1.5 m tall, unbranched; stems glabrous. *Leaves* elliptic to ovate or narrowly elliptic, 12–23 × 2.8–8.5 cm, at apex acute to acuminate, at base acute to cuneate or obtuse, drying papyraceous and discolorous, glabrous on both surfaces; secondary veins not visible or 10 to 14 pairs and barely discernible, plane on both surfaces; margins plane; *petioles* 1.8–2.5 cm long; *stipules* glabrous, sheath 1.5–2 mm long, broadly rounded, caducous, with interpetiolar appendage conical to triangular and flattened, 1.5–2.5 mm long, acute to shortly bifid, caducous, inserted medially. *Inflorescences* pseu-

doaxillary, paniculate, glabrous, ascending to spreading, pale yellow; peduncles 2–5.5 cm long; branched portion pyramidal to cylindrical, 2.5–5 × 2.5–5 cm, with developed secondary axes produced at 2 nodes, 2 or usually 3 per node, branched to several orders, first dichotomously once, then dichasially, then distally monochasially; bracts deltoid, 0.5–1.2 mm long, entire; *flowers* sessile, borne singly or in glomerules or congested dichotomous cymules of 2 to 5, later individual flowers and/or glomerules becoming separated by prolongation of axes; hypanthium turbinate, ca. 0.5 mm long, glabrous; *calyx limb* 0.8–1 mm long, glabrous, sinuate to 5-denticulate, entire; *corolla* in bud funnelform, cream, externally glabrous, tube to 3.5 mm long, lobes 5, to 1 mm long, abaxially smooth; *anthers* and *stigmas* not seen. *Infructescences* similar to inflorescences, with higher-order axes becoming prolonged and monochasial; *fruits* ellipsoid, ca. 7 × 6 mm, becoming orange then black, glabrous; pyrenes 2, dorsiventrally flattened, dorsally with 1 central, sharp, well-developed ridge with concave sides, margins thickened, sharp.

Habitat, distribution, and phenology. In wet premontane forest of southern Ecuador at 1000 to 1700 m; collected in flower in August, in fruit in July.

Notopleura hypolaevis is distinguished by its leaves with the secondary veins barely or usually not visible abaxially, its stipules with a well-developed sheath bearing a conical interpetiolar appendage, its paniculate pedunculate inflorescences, and its fruits that become orange then black. The specific epithet refers to the smooth, usually unveined abaxial leaf surface. *Notopleura hypolaevis* is similar to *N. iridescens* C. M. Taylor, which is sympatric, and to *N. uliginosa* of the Antilles, Central America, and Caribbean South America. *Notopleura uliginosa* differs from this new species in its leaves with the secondary veins visible and prominulous abaxially and its flowers pedicellate at anthesis; *N. iridescens* differs from this new species in its capitate to subcapitate inflorescences and stipitate fruits. The collection from the Cordillera de Cutucú (*H. Jorgensen CuJ-42*) has relatively narrower leaves but appears to be conspecific with the Ståhl collections.

Paratypes. ECUADOR. **Morona–Santiago:** eastern slope and crest of main Cordillera Cutucú, *H. Jorgensen CuJ-42* (NY); trail between 28 de Febrero and Kenkuim, *Ståhl et al. 2907* (AAU, GB).

I. 10. Notopleura longiflora C. M. Taylor, sp. nov. TYPE: Colombia. Antioquia: Medellín, San José de la Montaña, cuchilla Las Baldias, microcuenca La Iguaná, 6°20′02″N, 75°39′06″W, 2320–2850 m, 7 May 1997, *W. Rodríguez & F. Giraldo 698* (holotype, JAUM-25146). Figure 2C.

Haec species a congeneris foliorum venis secundariis cum marginibus incrassatis conjunctis et venatione tertiaria abaxialiter manifesta, inflorescentia congesta subcapitatave, bracteis floralibus 8–15 mm longis, calycis limbo 5–7.5 mm longo atque corollae glabrae tubo 12.5–14 mm longo distinguitur.

Terrestrial, succulent herbs or low shrubs to 0.4 m tall, unbranched or perhaps little-branched; stems densely hirtellous becoming glabrescent with age. *Leaves* elliptic to lanceolate, 3.5–7.5 × 1.5–2.5 cm, at apex acute, at base cuneate, drying papyraceous, adaxially glabrous, abaxially paler and glabrous except puberulous or hirtellous on costa and secondary veins; secondary veins 8 to 10 pairs, extending to and clearly united with margins, adaxially venation plane, abaxially costa prominent, secondary veins prominulous, and tertiary venation reticulated and thickened; margins markedly thickened, entire or shortly winged; *petioles* 3–12 mm long, hirtellous; *stipules* glabrous, persistent, interpetiolar, broadly triangular, 1–2 mm long, at apex obtuse to acute, with 1 glandular appendage 0.5–1 mm long, caducous. *Inflorescences* pseudoaxillary, capitate to subcapitate, hirtellous, ascending; peduncles 1 per axil, 2.5–4.5 cm long; heads 1 per peduncle, subhemispherical, 1–1.5 × 1.5–2.5 cm (not including corollas); bracts glabrous, narrowly triangular, 8–15 mm long, acute; *flowers* subsessile in glomerules or congested cymules of 2 to 5; hypanthium turbinate, ca. 0.8 mm long, glabrous; *calyx limb* glabrous, 5–7.5 mm long, divided nearly to base, lobes 5, narrowly triangular, acute; *corolla* infundibuliform, white, externally glabrous to sparsely puberulous, internally glabrous, tube 12.5–14 mm long, lobes 5, 3.5–6.5 mm long, lanceolate to ligulate, dorsally smooth; anthers ca. 1.5 mm long, situated just above middle of corolla tube; *stigmas* ca. 1 mm long, situated in corolla throat. *Infructescences* and *fruits* not seen.

Habitat, distribution, and phenology. In wet montane forest at 2800 to 2900 m, in the Cordillera Central of northwestern Colombia; collected in flower in February, May, and July.

Notopleura longiflora is distinguished by the combination of its distinctive leaf venation with the secondary veins uniting with the thickened margins and the tertiary venation visible abaxially, its con-

gested to subcapitate inflorescences, its well-developed bracts, its relatively long calyx limb, and its relatively long glabrous corollas. The corollas are apparently the longest in the genus; the species epithet refers to this characteristic. This new species is similar to *N. zarucchiana* (described later in this article); their distinctions are discussed under this second species. Also similar to *N. longiflora* is *N. macropodantha* of the northern Cordillera Oriental of the Andes, in northeastern Colombia; *N. macropodantha* differs from this new species in its calyx limb ca. 2 mm long, corolla tubes 3–4 mm long, and corolla lobes ca. 1.5 mm long. *Notopleura longiflora* is included in the "*Notopleura macropodantha* group" discussed in the introductory part of this article.

Paratypes. COLOMBIA. **Antioquia:** Medellín, San Cristóbal, Cerro del Padre Amaya, microcuenca Iguaná, *F. Giraldo et al. 1720* (JAUM), *W. Rodríguez & Duque 1034* (JAUM).

I. 11. Notopleura longipedunculoides (C. M. Taylor) C. M. Taylor, comb. nov. Basionym: *Psychotria longipedunculoides* C. M. Taylor, Fieldiana, Bot. n.s. 33: 257. 1993, nom. nov. *Psychotria longipedunculata* Dwyer, Ann. Missouri Bot. Gard. 67: 389. 1980, nom. illeg., not *Psychotria longipedunculata* (Gardner) Müller Argoviensis, Fl. Bras. 6(5): 237. 1881. TYPE: Panama. Veraguas: valley of Río Dos Bocas, 15.6 km NW of Santa Fé, road between Escuela Agrícola Alto Piedra and Calovébora, 450–550 m, 31 Aug. 1974, *T. B. Croat 27621* (holotype, MO-2203532).

Taylor (2001a) previously attempted to name this species in *Notopleura*, but mistakenly based the combination on the illegitimate name *Psychotria longipedunculata* Dwyer. The legitimate name *P. longipedunculoides* C. M. Taylor should have been used instead, as done here.

I. 12. Notopleura longissima Bremekamp, Rec. Trav. Bot. Néerl. 31: 290. 1934. *Psychotria longissima* Standley, Publ. Field Columbian Mus., Bot. Ser. 7: 102. 1930, nom. illeg., not *Psychotria longissima* Quisumbing & E. D. Merrill, Philipp. J. Sci. 37: 206. 1928. TYPE: Colombia. Valle: Córdoba, 80–100 m, 6–8 May 1922, *E. P. Killip 5134* (holotype, US-1140557; isotypes, GH not seen, NY not seen).

Taylor (2001a) incorrectly published a combination in *Notopleura* based on *Psychotria longissima* Standley, but this species was previously named in *Notopleura* by Bremekamp. Standley's *Psychotria* name is an illegimate later homonym and thus cannot be a basionym for a combination, so Bremekamp provided a new name for this species in *Notopleura* rather than a combination.

I. 13. Notopleura madida (Standley) C. M. Taylor, comb. nov. Basionym: *Psychotria madida* Standley, Publ. Field Columbian Mus., Bot. Ser. 7(2): 226. 1931. TYPE: Ecuador. Chimborazo: Huigra, mostly on the Hacienda de Licay, 3 Sep. 1918, *J. N. Rose & G. Rose 22507* (holotype, US-1022160 not seen, photo F neg. #66727; isotype, F-587094).

This species was not included in *Notopleura* by Taylor (2001a) because its identity was then unclear. With more material now available it can be seen to be a distinct species of *Notopleura*. *Notopleura madida* is distinguished by it stipules with a conical interpetiolar appendage ca. 1 mm long, pseudoaxillary rounded-corymbiform inflorescences, bracts 1.5–6 mm long, calyx limbs 2.2–3 mm long, white fruits, and dorsiventrally flattened pyrenes. It is similar in general aspect to *N. corymbosa*; *N. corymbosa* differs from *N. madida* in its stipule with the interpetiolar appendage laminar and larger, 6–20 mm long. *Notopleura madida* is only known from Chimborazo Province, Ecuador.

I. 14. Notopleura micayensis (Standley) Bremekamp, Rec. Trav. Bot. Néerl. 31: 290. 1934. *Psychotria micayensis* Standley, Publ. Field Columbian Mus., Bot. Ser. 7: 105. 1930. TYPE: Colombia. Cauca: La Gallera, Micay Valley, 1200–1500 m, 20–30 June 1922, *E. P. Killip 7760* (holotype, US-1140625).

Taylor (2001a) incorrectly attempted to make this combination again, but it was previously published by Bremekamp.

I. 15. Notopleura montana C. M. Taylor, sp. nov. TYPE: Colombia. Valle del Cauca: Cordillera Occidental, hoya del Río Calima, El Cairo, entre Darién y Mediacanoa, 1650–1750 m, 7 Jan. 1943, *J. Cuatrecasas 13944* (holotype, F-1244588). Figure 5C, D.

Haec species a congeneris appendicibus stipularibus interpetiolaribus conicis succulentis, inflorescentia cymosa pedunculo bene evoluto insidente atque pyrenarum dorsiventraliter complanatarum marginibus et costa abaxiali centrali bene evolutis distinguitur.

Terrestrial, erect, succulent herbs or soft shrubs to 2(5) m tall, unbranched; stems glabrous. *Leaves* elliptic to narrowly elliptic, obovate, or elliptic-oblong, 18–35 × 7–16 cm, at apex deltoid to usually

acuminate, at base obtuse to usually acute or attenuate, drying papyraceous to membranaceous, glabrous on both surfaces, often paler abaxially; secondary veins 14 to 20 pairs, looping to interconnect at least in distal half of blade, with submarginal vein usually well-developed, adaxially venation plane, abaxially costa prominent, secondary veins prominulous, and remaining venation plane and invisible; margins plane; *petioles* 1.5–6 cm long; *stipules* glabrous, sheath 3–4 mm long, truncate to broadly rounded, usually persistent and becoming dry and indurated, interpetiolar appendage conical to deltoid, 3–5 mm long, succulent, divergent, inserted medially, acute, caducous, abaxially glandular. *Inflorescences* pseudoaxillary, paniculate, ascending, green, puberulous to glabrescent; peduncles 7.5–22 cm long, those of lower nodes markedly longer than those of upper nodes; branched portion cylindrical, 5–14 × 2.5–10 cm, with developed secondary axes at 3 to 4 nodes, 2 per node, dichasially branched to several higher orders; bracts deltoid to ovate, entire, those subtending secondary axes 1–4 mm long, those subtending flowers or glomerules 0.5–1 mm long; *flowers* sessile, borne along inflorescence axes singly or in glomerules of 2 to 3; hypanthium turbinate, ca. 0.8 mm long, glabrous; *calyx limb* 0.3–0.8 mm long, glabrous to puberulous, sinuate to irregularly denticulate; *corolla* salverform, white, externally glabrous, internally not seen, tube ca. 4.5 mm long, lobes 5, 1.2–1.5 mm long, narrowly triangular, abaxially smooth or with appendage up to 0.3 mm long, rounded; *anthers* not seen; *stigmas* 2, linear, ca. 0.8 mm long, exserted. *Infructescences* similar to inflorescences; *fruits* ellipsoid to orbicular, 4–6 × 5–5.5 mm, white, glabrescent, sessile; *pyrenes* 2, strongly dorsiventrally flattened, dorsally with 1 central, sharp, well-developed ridge, margins markedly thickened, rounded to rather sharp.

Habitat, distribution, and phenology. In wet forest at 850 to 1950 m, in montane regions of eastern Costa Rica and adjacent western Panama, and in the Andean Cordillera from central western Colombia to Venezuela and central Peru; collected in flower in January, in fruit in January and March through October.

Notopleura montana is distinguished by its leaves with the tertiary and higher-order venation not visible, its conical succulent interpetiolar stipule appendages, its well-developed peduncles, its cylindrical inflorescences with the axes dichasially branched and the flowers borne along them individually or in small glomerules, its reduced calyx limbs, its white fruits, and its pyrenes that are markedly dorsiventrally flattened and dorsally have only one sharp ridge and thickened margins. *Notopleura montana* has been confused previously with *N. macrophylla*; *N. macrophylla* differs from this new species in its leaves with the reticulated tertiary and often higher-order venation visible, its peduncles 1–7 cm long, and its pyrenes that are triangular to umbonate in cross section with the central ridge rounded. One collection from Peru (*Schunke 5925*, F) is in fact a mixture of these two species, with leaves and an inflorescence of *N. montana* mounted together with two separated inflorescences of *N. macrophylla*. The specific epithet refers to the distribution of this species in exclusively premontane and montane forests.

Only one mature corolla has been seen, on the holotype. This was not dissected, so consequently the pattern of internal corolla pubescence and the size and position at anthesis of the apparently included anthers are unknown. Although this species is widely distributed, it has been collected with frequency only in Valle Department in western Colombia; this pattern may be due to the rarity of this species through most of its range, or to the rather good level of exploration in Valle Department.

Paratypes. COLOMBIA. **Putumayo:** Mocoa, San Antonio, vereda Alto Campucana, Finca La Mariposa, *J. L. Fernández et al. 10759* (GB, NY), *11040* (MO). **Quindío:** Bremen, 15 km N of Armenia, *Gentry et al. 65319* (MO). **Valle:** Reserva Natural de Yotoco de la Universidad Nacional, Cordillera Occidental, vertiente oriental, Km 18 de la carretera Buga–Madroñal, *Bay 312* (MO), *Devia 1086* (MO), *3008* (MO), *Silverstone-Sopkin & Paz 7538* (CUVC, MO); along old highway between Cali and Buenaventura, 28 km beyond junction with new highway (20 km W of village of Borrero Ayerbe and 7 km W of El Salado), *Croat 38624* (MO); Yotoco, Cordillera Occidental, eastern slopes, along highway between Dapa and Loboquerrero at Parque Yotoco, *Croat 70728* (MO); along road betwen Queremal and Anchicayá, 2 km W of Queremal, *Croat & Gaskin 79647* (MO); "El Topacio," dentro del Parque Nacional Natural Los Farallones de Cali, *S. Sarria 5T* (MO). COSTA RICA. **Puntarenas:** above coffee fincas along Río Coto Brus, near Coton, 23 km W of La Unión (on Panama border), *Croat 26590* (MO); foothills of the Cordillera de Talamanca, along Río Bella Vista, NW of Las Alturas, *Davidse 24330* (MO); Coto Brus, Reserva de la Biósfera de La Amistad, ca. Estación Biológica Las Alturas de Cotón, *Kress & Dew 94–4082* (MO). **San José:** vicinity of El General, *Skutch 2741* (MO). ECUADOR. Without province: Napo–Pastaza [probably now Sucumbíos], zone of Sofía, valley of Río Chingual, *Steere 8343* (F). **Morona–Santiago:** ridge between Ríos Itzintza and Chupiasa, Cordillera Cutucú, *Camp E-1290* (US); along road from Gualaquiza to Zamora ca. 3 km S of Río Bomboiza, *Croat 50798* (MO); road Limón (General Plaza)–Macas, ca. Km 20 from Limón, *Harling & Andersson 12851* (MO). **Napo:** Archidona, comunidad de Pacto Sumaco, sector suroccidental, *A. Alvarez et al. 1954* (MO, QCNE); Archidona, Reserva Ecológica Antisana, comunidad Shamato, entrada por Km 21–Shamato, *J. L. Clark et al. 5138* (MO); Quijos

River region below Baeza, ca. 10 km NW of Chaco, *Ownbey 2664* (F); ridge above Río San Juan Grande, ca. 9.5 km (by road) NW of El Chaco, *Ståhl et al. 2198* (GB). PANAMA. **Chiriquí:** on NW side of Cerro Pando cloud forest, *Croat 15959* (MO). PERU. **Pasco:** Oxapampa, Río El Tunqui ca. 50 km from Oxapampa, *D. N. Smith et al. 1721A* (MO); Palmazú, *D. N. Smith 8547* (MO). **San Martín:** Lamas, San Juan Pacayzapa, al E de puente (carretera a Moyobamba), *Schunke 5925* (F). VENEZUELA. **Yaracuy:** depto. Urachiche, a lo largo de la carretera entre Buenos Aires y Guamales, parte occidental de la Sierra de Aroa, al N de Urachice, *Steyermark et al. 114094* (F).

I. 16. Notopleura multinervia C. M. Taylor, sp. nov. TYPE: Panama. Chiriquí: along road between Gualaca and the Fortuna Dam site, at 10.1 m; [sic; mi] NW of Los Planes de Hornito, 1300 m, 8 Apr. 1980, *T. Antonio 4061* (holotype, MO-2783578). Figure 1E, F.

Haec species a *Notopleura aggregata* et *N. tonduzii* foliorum venis secundariis pluribus, bracteis floralibus brevioribus atque tubo corollino ca. 4 mm longo distinguitur.

Succulent, erect, terrestrial herbs or soft shrubs to 1.5(3) m tall, unbranched; stems glabrous. *Leaves* elliptic-oblong to elliptic, oblanceolate, or ovate, 14.5–22 × 5–9 cm, at apex acuminate, at base acute to obtuse, drying papyraceous, on both surfaces glabrous, abaxially sometimes paler; secondary veins 16 to 26 pairs, looping to interconnect, abaxially venation plane or costa prominulous, abaxially costa prominent, secondary veins prominulous, and remaining venation plane and invisible or often intersecondaries visible; margins plane; *petioles* 1–4.5 cm long; *stipules* glabrous, sheath 1–1.5 mm long, truncate, persistent, with an interpetiolar appendage inserted medially, ligulate to triangular or oblanceolate, 4–8 mm long, divergent to ascending, succulent, flattened, acute to fimbriate with segments linear and apparently glandular, margins winged, hyaline. *Inflorescences* pseudoaxillary, paniculate, green, puberulous, spreading to deflexed; peduncles 0.5–2 cm long; branched portion pyramidal, 3–5 × 4–6 cm, with secondary axes developed at 2 to 3 nodes, 2 per node, spreading usually at more than 90°, branched to 1 or rarely 2 more order(s), axes terminating in floral glomerules; bracts acute, entire, those subtending secondary axes triangular to ovate, 1–6 mm long, those subtending flowers narrowly triangular to lanceolate or ovate, 1–2 mm long; *flowers* sessile in glomerules of 3 to 9; hypanthium turbinate, 0.8–1 mm long, glabrous; *calyx limb* puberulous, ca. 0.8 mm long, 5-lobed for 1/3–1/2, lobes triangular; *corolla* salverform, white, externally glabrous, internally glabrous except hirtellous at stamen insertion, tube ca. 4 mm long, lobes 5, ca. 2 mm long, abaxially with an appendage 0.5–0.8 mm long, conical to rounded; *anthers* ca. 0.8 mm long, positioned in corolla throat; *stigmas* 2, linear, ca. 1 mm long, positioned in corolla throat. *Infructescences* similar to inflorescences; *fruits* ellipsoid, 6–7 × 5.5–6 mm, white, glabrous, sessile; *pyrenes* 2, dorsiventrally markedly flattened, dorsally with 1 sharp, central, longitudinal ridge, sometimes also with 2 weaker lateral ridges, margins thickened and usually sharp.

Habitat, distribution, and phenology. In wet forest at 1000 to 1700 m in western Panama; collected in flower March through June, in fruit in February, March, June, August, September, and November.

Notopleura multinervia is similar to *N. aggregata*, *N. tonduzii*, and *N. parvifolia* (this last is described later in this article). *Notopleura multinervia* differs from these in its more numerous secondary leaf veins with usually well-developed intersecondary veins, its shorter floral bracts, and its corolla tubes ca. 4 mm long. *Notopleura aggregata* differs from *N. multinervia* in its secondary leaf veins 9 to 16 pairs, its peduncles 1–13 cm long with the secondary axes ascending at less than 90° with relation to the primary axis, its floral bracts 2–3 mm long, its calyx limbs 1–2 mm long, and its corolla tubes ca. 5 mm long; *N. tonduzii* differs from *N. multinervia* in its secondary leaf veins 10 to 16 pairs, its floral bracts 1.5–3 mm long, its corolla tubes ca. 3 mm long, its inflorescences with the secondary axes usually as well-developed as the primary axis (vs. shorter than it in *N. multinervia*), and its corolla lobes with abaxial appendages ca. 0.3 mm long; *N. parvifolia* differs from *N. multinervia* in its calyx limbs 1–1.8 mm long with narrowly triangular to linear lobes, its corolla lobes ca. 1.5 mm long with abaxial appendages 1–1.5 mm long, and its inflorescences that are smaller and more congested. This new species was first recognized as a distinct taxon by John D. Dwyer, who annotated its specimens as a subspecies of *N. macrophylla* with the epithet "*multinervia*" but never published the name. Unlike most species of *Notopleura*, the specimens studied of *N. multinervia* all bear either flowers or nearly to fully mature fruits, but not both stages concurrently on the same plant. *Notopleura multinervia* is included in the "*Notopleura aggregata* group" discussed in the introductory part of this article.

Paratypes. PANAMA. **Bocas del Toro/Chiriquí Border**: Continental Divide above Quebrada Arena, carretera de oleoducto, IRHE Fortuna Hydroelectric Project, *Knapp & Vodicka 5669* (MO). **Chiriquí:** vicinity of Gualaca ca. 8.5 mi. from Planes de Hornito, La Fortuna on road to damsite, *Antonio 5098* (MO); Fortuna Dam area,

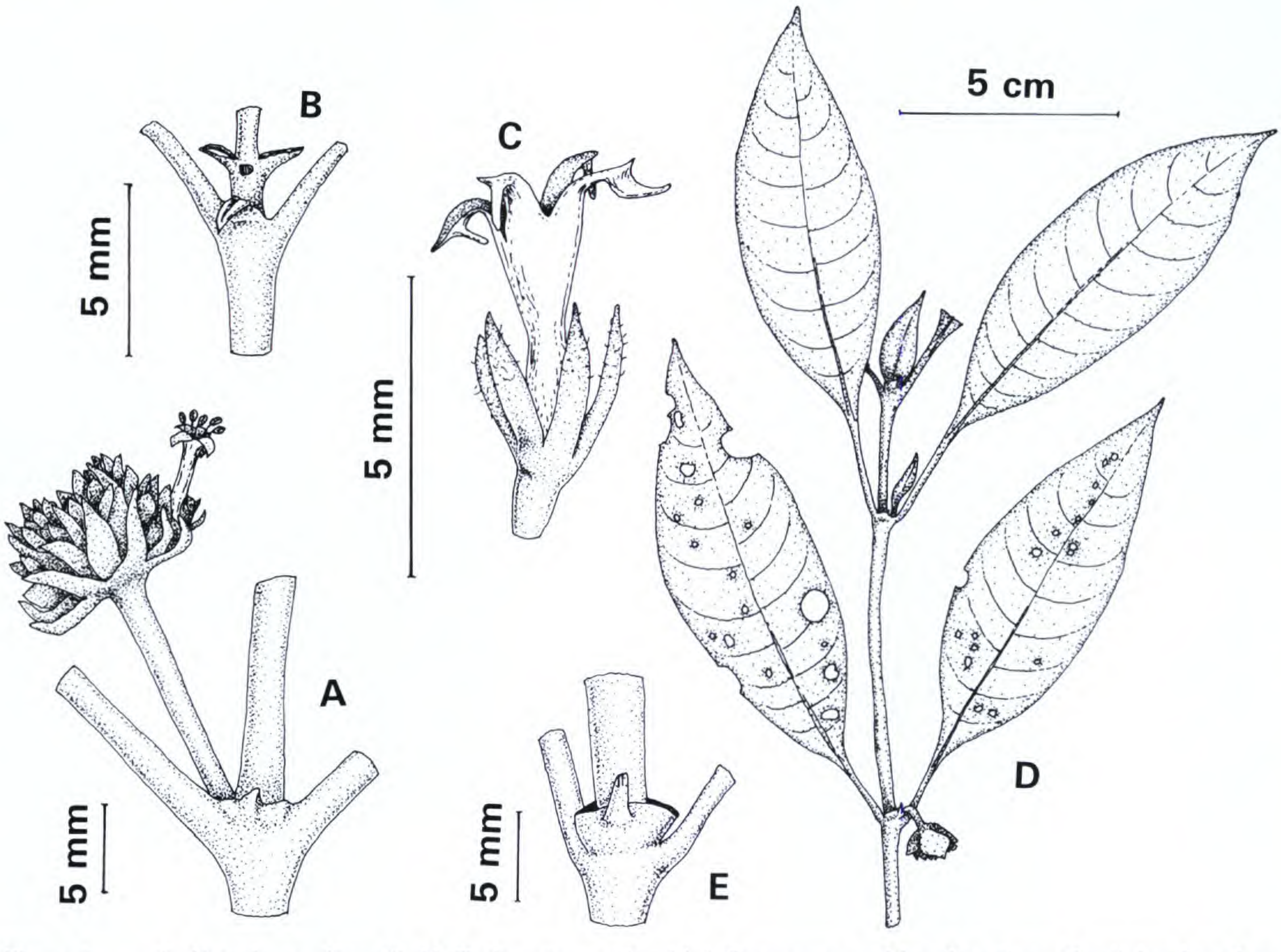

Figure 6. —A. *Notopleura obtusa* C. M. Taylor, stem node with inflorescence and basal portions of petioles; based on *Lugo S. 4168* (MO). B, C, *Notopleura pacorana* C. M. Taylor; based on *de Nevers et al. 5525* (MO). —B. Stem portion with two nodes and basal portions of petioles. —C. Flower at anthesis. D, E, *Notopleura penduliflora* C. M. Taylor; based on *Hammel & Krager 3925* (MO). —D. Stem with leaves and inflorescence. —E. Stem node with basal portions of petioles.

along Quebrada Bonito to E of road, *Churchill et al. 4732* (MO), between Quebrada Los Chorros and Quebrada Hondo, to N of reservoir, *Churchill & Churchill 6182* (MO); along road to Fortuna Dam Site, N of Gualaca, 22.7 mi. beyond the bridge over the Río Esti, 11.8 mi. N of Los Planes de Hornito, 10.7 mi. N of junction to tunnel, *Croat 48642* (MO); along road from Gualaca to Fortuna dam site, 5.9 mi. NW of Los Planes de Hornito, *Croat 49894* (MO), 7.9 mi. NW, *Croat 49922* (MO); along road between Fortuna Lake and Chiriquí Grande, 4.5–5 km N of dam over Fortuna Lake, *Croat & Grayum 60047* (MO); along highway between Gualaca and Chiriquí Grande, along boundary trail between Bocas del Toro and Chiriquí Provinces, *Croat 66833* (MO); Gualaca–Chiriquí Grande, 8.4 mi. beyond Los Planes de Hornito, 7.3 mi. beyond turnoff to Caldera, *Croat 67860* (MO); Fortuna Dam site, *Folsom et al. 5407* (MO, PMA), *5488* (MO); near Fortuna Dam, *Hampshire & Whitefoord 213* (MO, PMA); forest behind Vivero Forestal, 9 km N of Los Planes de Hornito, IRHE Fortuna Hydroelectric Project, *Knapp et al. 4100* (MO), 12 km N, *Knapp 4964* (MO), *Knapp & Vodicka 5536* (MO), 8 km N, *Knapp 4992* (MO), 10 km N, *Knapp & Vodicka 5612* (MO); vicinity of Fortuna Dam, along trail near Río Hornito, *McPherson 9895* (MO); Boquete, Fortuna dam site, Continental Divide, *van der Werff & van Hardeveld 6771* (MO). **Veraguas:** Cerro Tute, ca. 10 km NW of Santa Fe, *Mori et al. 7582* (MO).

I. 17. Notopleura obtusa C. M. Taylor, sp. nov. TYPE: Ecuador. Pastaza: Río Challuna, ca. 15 km N of Puerto Sarayacu, 16 Oct. 1974, *H. Lugo S. 4168* (holotype, GB; isotypes, MO-4903139, US). Figure 6A.

Haec species a *Notopleura aequatoriana* inflorescentia capitata, foliis deltoideis obtusisve usque rotundatis truncatisve atque lobulis corollinis processus conicos 0.5–0.8 mm longos gerentibus distinguitur.

Rather succulent, terrestrial herbs or subshrubs to 0.8(2) m tall; stems glabrous to densely hirtellous. *Leaves* elliptic to obovate, 7.5–15.5(19) × 4–7(9) cm, at apex deltoid or obtuse to rounded or truncate, at base cuneate to obtuse, drying papyraceous, adaxially glabrous, abaxially paler and sparsely strigillose to densely hirtellous; secondary veins 6 to 12 pairs, not looping to interconnect, adaxially costa plane to prominulous and remaining venation plane, abaxially costa prominent, secondary veins prominulous, and remaining venation plane and invisible; *petioles* 1–3.5 cm long, gla-

brous to densely hirtellous; *stipules* glabrous to hirtellous, united around stem into a continuous sheath 1–2 mm long, truncate, interpetiolar portion with 1 appendage, this conical to pyramidal, 1–2 mm long, inserted medially, divergent, this and the sheath persistent or deciduous. *Inflorescences* pseudoaxillary, capitate, glabrous to densely hirtellous, ascending; peduncles 0.3–2 cm long; heads 1 per axil, subglobose to hemispherical, 1–1.5 × 1.2–1.5 cm; bracts 6–8 mm long, those external to capitula narrowly triangular to deltoid, acute, those subtending flowers narrowly elliptic to oblanceolate, acute to rounded; *flowers* sessile; hypanthium not seen; *calyx limb* glabrous, ca. 0.5 mm long, entire or lobed to 1/2, lobes triangular; *corolla* infundibuliform, white, externally glabrous, internally glabrous except densely hirtellous in upper (distal) half, tube ca. 6 mm long, lobes 5, ca. 1.5 mm long, deltoid, abaxially with an appendage 0.5–0.8 mm long, conical, inserted medially; *anthers* ca. 1 mm long, exserted; *stigmas* not seen. *Infructescences* similar to inflorescences or sometimes more open, to 2 × 3.5 cm with 1 pair of secondary axes; *fruits* ellipsoid, ca. 5 × 5 mm, glabrous, red; *pyrenes* 2, dorsiventrally flattened, dorsally with 1 well-developed, sharp central ridge and 2 smaller lateral ridges.

Distribution, habitat, and phenology. In wet forest at 200 to 1285 m, Amazonian central Ecuador to northeastern Peru; collected in flower in July through October, and December, in fruit in April, May, and July through December.

Notopleura obtusa is distinguished by the combination of is leaves deltoid or obtuse to usually rounded or truncate at the apex, its stipules with the pyramidal to conical interpetiolar appendage inserted medially on the sheath, its capitate inflorescences with peduncles 0.3–2 cm long, and its corollas with relatively well-developed projections on the abaxial surfaces of the lobes. These corolla lobe appendages give the tops of the flower buds a "five-horned" appearance, and are easily mistaken for the corolla lobes themselves. The specific epithet refers to the most frequent shape of the leaf apices, which is unusual (though not unique) in *Notopleura*. This new species is similar to *N. aequatoriana*; *N. aequatoriana* differs from this new species in its leaves obtuse to acute at the apex, its inflorescences that are sometimes capitate but more often branched with 1 to 2 pairs of developed secondary axes, its peduncles 3.5–10 cm long, and its corolla lobes that are dorsally smooth or with a thickening to only ca. 0.3 mm high. The fruits of *N. obtusa* are described as red on all specimens seen, though it is possible that as in several other *Notopleura* species, they finally turn black when fully mature.

Paratypes. ECUADOR. **Napo:** Archidona, Reserva Ecológica Antisana, comunidad Shamato, entrada por Km 21- [sic] Shamato, *J. L. Clark et al. 5128* (MO, QCNE); along new road from Pangayacu to Loreto, 10.6 km E of main N–S road between Baeza and Tena (departing main road 23.7 km N of Archidona), *Croat 58794* (MO); Parque Nacional Yasuní, pozo petrolero Daimi I, Conoco, *F. Hurtado et al. 28* (MO); 2 km S of Coca, Reserva Florística El Chuncho, *Persson 131* (GB); Aguarico, Reserva Etnica Huaorani, carretera y oleducto de Maxus en construcción, Km 92–96, al N del Río Yasuní, *M. Aulestia & Gonti 2089* (MO, QCNE); Aguarico, Reserva Etnica Huaorani, Maxus road and pipeline construction project, Km 99–100, *Pitman 467* (MO, QCNE). **Pastaza:** Pastaza, pozo petrolero "Masaramu" de Unocal, 40 km al NE de Montalvo, *Espinoza 172* (MO, QCNE); village of Molino, 45 min. by small plane from Puyo on Bobonaza River, *King et al. 1051* (NY); Río Zupayacu, ca. 7 km E of Puerto Sarayacu, *H. Lugo S. 4083* (GB, US); Río Capahuari, ca. 12 km N of Puerto Sarayacu, *H. Lugo S. 4101* (GB, MO, US); Río Curiacu, ca. 8 km W of Puerto Sarayacu, *H. Lugo S. 4232* (GB); road Puyo–Macas (under construction), 31 km from Puyo, *Øllgaard & Balslev 9043* (NY). PERU. **Amazonas:** valle del Río Santiago, ca. 65 km N of Pinglo, Quebrada Caterpiza, 2–3 km atrás de la comunidad de Caterpiza, *Huashikat 1429* (MO). **Loreto:** Maynas, near villa Nueva, Borro Indian village on upper Río Yaguasyacu, tributary of Río Ampiyacu, *Gentry & Revilla 20446* (MO); Loreto, Valseca–Rudolpho, Río Corrientes between Quebrada Platanoyacu and mouth of Río Macusari, *McDaniel & Barcos 11062* (MO).

I. 18. Notopleura pacorana C. M. Taylor, sp. nov. TYPE: Panama. Panamá–San Blas: trail from end of road past Los Altos de Pacora region of Cerro Jefe on to Cerro Brewster, 9°17′N, 79°17′W, 600–800 m, 20–25 Apr. 1985, *B. Hammel & G. de Nevers 13566* (holotype, MO-3842303). Figure 6B, C.

Haec species a congeneris foliis satis parvis, stipulis vaginantibus appendicem interpetiolarem conicam succulentam gerentibus, inflorescentia capitata, lobulis corollinis dorsaliter appendiculatis atque fructu albo satis parvo distinguitur.

Terrestrial, succulent, erect herbs or soft shrubs to 1.5 m tall, unbranched; stems puberulous to glabrescent. *Leaves* elliptic to elliptic-oblong or oblanceolate, 9.5–15 × 4–8 cm, at apex acute to shortly acuminate, at base acute to cuneate, drying papyraceous to chartaceous, adaxially glabrous, abaxially somewhat paler and densely puberulous to pilosulous at least on secondary veins, becoming glabrescent with age; secondary veins 7 to 10 pairs, not looping to interconnect, adaxially costa prominulous and remaining venation plane, adaxially costa prominent, secondary veins prominulous, and

remaining venation plane and usually invisible; *petioles* 1–4.5 cm long, hirtellous or pilosulous to glabrescent; *stipules* puberulous to glabrescent, 2–3 mm long, interpetiolar, broadly triangular, persistent on distalmost 2 to 3 nodes, with a conical, succulent, divergent appendage 2–3 mm long, entire to shortly bifid, glandular at apex, caducous. *Inflorescences* pseudoaxillary, capitate, moderately to densely hirtellous or pilosulous, ascending to deflexed, green; peduncles 0–5 mm long; heads 1 per axil, subglobose, 8–15 mm diam.; bracts oblanceolate to ligulate or triangular, 2.5–5 mm long, acute to obtuse or rounded, flat or sometimes somewhat cucullate; *flowers* sessile; hypanthium turbinate, ca. 1 mm long, glabrous; *calyx limb* densely pilosulous to hirtellous, 1.5–3 mm long, lobed for ca. 3/4, lobes 5, narrowly triangular, acute; *corolla* salverform, white, externally and internally glabrous, tube ca. 4 mm long, lobes 5, narrowly triangular, ca. 2 mm long, acute, dorsally with 1 linear appendage ca. 1 mm long, puberulous; *anthers* ca. 1 mm long, situated in corolla throat; *stigmas* 2, linear, ca. 1 mm long, situated just above anthers. *Infructescences* similar to inflorescences; *fruits* ellipsoid, 4–4.5 × 3.5 mm, white, glabrous; *pyrenes* 2, strongly dorsiventrally flattened, dorsally with 1 sharp central ridge and margins not or only slightly thickened.

Habitat, distribution, and phenology. In wet forest at 600 to 850 m, Caribbean slopes of central Panama; collected in flower in February, April, and May, in fruit in April and October.

Notopleura pacorana is distinguished by its relatively small leaves, sheathing stipules with a succulent conical interpetiolar appendage, capitate inflorescences, dorsally appendaged corolla lobes, and relatively small white fruits. It is known only from a relatively small region in Caribbean central Panama; the specific epithet refers to this range. This new species is similar to *N. panamensis* and *N. capitata* (decribed above). *Notopleura panamensis* differs from *N. pacorana* in its leaves 20–30 cm long with 13 to 22 pairs of secondary veins, its calyx limbs 3.5–4.5 mm long, and its fruits ca. 7 × 5 mm; *N. capitata* differs from *N. pacorana* in its leaves 16–35 cm long with 10 to 17 pairs of secondary veins and its fruits 5–6 × 4.5–5 mm.

Paratypes. PANAMA. **Panamá:** road to Altos de Pacora, near schoolhouse, *Mori & Kallunki 2366* (MO); 5–10 km NE of Altos de Pacora, on trail at end of road, *Mori & Kallunki 6048* (MO); Cerro Jefe, 6 km past Cerro Azul on road to Altos Pacora, *Sytsma & D'Arcy 3677* (MO, PMA). **San Blas:** Cerro Brewster, *de Nevers et al. 5525* (MO).

I. 19. Notopleura parvifolia C. M. Taylor, sp. nov. TYPE: Panama. Coclé: El Copé, on Continental Divide above town, 8°38′N, 80°38′W, 700–900 m, 27–29 Apr. 1985, *B. Hammel 13678* (holotype, MO-3616173).

Haec species a *Notopleura aggregata* inflorescentia fasciculata sessili vel perbreve pedunculata atque foliis pro medio satis parvis distinguitur.

Erect, succulent, terrestrial herbs or soft shrubs to 1.5 m tall, unbranched; stems glabrous or puberulous to glabrescent. *Leaves* elliptic-oblong to oblanceolate, 10–24 × 3–8 cm, at apex acute to usually acuminate, at base acute to obtuse, drying papyraceous, adaxially glabrous, abaxially glabrous or densely puberulous to glabrescent and often somewhat paler; secondary veins 10 to 16 pairs, looping to interconnect at least in distal part of blade, adaxially venation plane, abaxially costa and secondary veins prominulous and remaining venation plane and invisible except intersecondaries usually developed and visible; margins plane; *petioles* 1–4.5 cm long; *stipules* with sheath 1–3 mm long, truncate, glabrous, persistent with leaves, with interpetiolar appendage narrowly ligulate to oblanceolate, 4–5 mm long, inserted medially, ascending, glabrous to usually puberulous, flattened, usually persisting at least on distalmost 3 to 5 nodes, at apex rounded to acute, bilobed shortly or to 1/3, lobes narrowly triangular to linear, apparently glandular at least at apex. *Inflorescences* pseudoaxillary, congested-paniculate to subcapitate, green, spreading to deflexed, densely puberulous; peduncles 0–1 cm long; flowering portion subcapitate, 0.5–1 cm diam., subglobose or somewhat trilobed, or sometimes branched, fasciculate to pyramidal, to 2.5 × 5 cm, with developed secondary axes present at 1 node, 2 per node, the axes terminating in glomerules or congested cymules; bracts entire, acute, those subtending secondary axes or glomerules triangular, 3–5 mm long, those subtending flowers narrowly triangular, 2–3 mm long; *flowers* sessile in glomerules of 5 to 15; hypanthium turbinate, ca. 0.8 mm long, glabrous to densely puberulous; *calyx limb* 1–1.8 mm long, glabrous to densely puberulous, 5-lobed for 2/3–3/4, lobes narrowly triangular to linear, acute; *corollas* salverform, white, externally glabrous to densely puberulous, internally glabrous except apparently hirtellous near middle, tube ca. 4 mm long, lobes 5, ca. 1.5 mm long, narrowly triangular, abaxially with appendage linear, 1–1.5 mm long; *anthers* ca. 1 mm long, exserted; *stigmas* 2, linear, ca. 1 mm long, exserted. *Infructescences* similar to inflorescences; *fruits* ellipsoid, 5–7 × 4–5.5 mm, white, glabrous, sessile; *pyrenes*

2, dorsiventrally flattened, dorsally with one sharp, central, longitudinal ridge, margins rounded to rather sharp.

Habitat, distribution, and phenology. In wet forest at 400 to 1400 m throughout Panama, and likely also in adjacent Colombia though not yet known from there; collected in flower March through July, in fruit in March and June through November.

Notopleura parvifolia is a species similar to *N. aggregata*, but *N. aggregata* differs from this new species by its inflorescences that are branched with peduncles 2.2–13 cm long and its leaves 12–32 × 4–12.5 cm. The specific epithet refers to the smaller leaf size of this new species. *Notopleura multinervia*, described above, is also similar to *N. parvifolia*; their distinctions are discussed under *N. multinervia*. *Notopleura parvifolia* is included in the "*Notopleura aggregata* group" discussed in the introductory portion of this article.

Paratypes. PANAMA. **Chiriquí:** end of road past Palo Alto to Bocas, *Hammel 6524* (MO). **Coclé:** El Copé on Pacific side 1/2 hour walk from sawmill, *Antonio 2170* (MO); Cerro Pilón (above El Valle de Antón), *Croat 14532* (MO), *Dwyer & Lallathin 8957* (MO); Alto Calvario, above El Copé, ca. 6 km N of El Copé, Atlantic slope along trail which leads W off old lumber trail which leads down to Las Ricas, Limón, and San Juan, *Croat 68731* (MO); top of ridge N of El Copey [sic; Copé], El Petroso, *D'Arcy 11315* (MO); Cerro Gaital Caracoral, *Dwyer & Correa 8977* (MO, PMA); New Works at Rivera sawmill, Alto Calvario, 7 km N of El Copé, *Folsom 3156* (MO), *4949* (MO), *Folsom & Collins 6448* (MO, PMA); 3-mountain ridge above El Valle, 8°40′N, 80°10′W, *Hamilton et al. 4134* (MO); El Copé on slope and ridge W of sawmill, *Hammel 2411* (MO); El Copé, on Continental Divide above town, *Hammel 13647* (MO); foothills and summit of Cerro Caracoral near La Mesa, N of El Valle de Anton, *Knapp 1154* (MO, PMA); N of El Valle, E slopes and ridges leading to Cerro Gaital, *Knapp 5332* (MO, PMA), *5774* (MO); La Mesa, 2 km W of Cerro Pilón, *Sullivan 545* (MO); above El Potroso sawmill at Continental Divide N of El Copé, *Sytsma & Andersson 4557* (MO). **Darién:** 0–1 mi. E of Tres Bocas along shortest headwater of Río Coasi, *Kirkbride & Duke 1182* (MO). **Panamá:** El Llano–Cartí Road, 10–12 km from El Llano, *Maas & Dressler 1703* (MO). **Veraguas:** valley of Río Dos Bocas along road between Escuela Agrícola Alto Piedra and Calovébora, 15.6 km NW of Santa Fe, *Croat 27620* (MO); 0.6 mi. beyond Escuela Agrícola Alto Piedra, *Croat & Folsom 34018* (MO); Alto de Piedra, vicinity of Santa Fe along ridge which extends to summit from edge of a plantation along road less than 1 km from Escuela Agrícola Alto de Piedra, on road to N going to Río San Luis, *Croat 66976* (MO); vicinity of Santa Fe, along road between Alto Piedra and Calovebora, 0.5 mi. N of Alto Piedra on slopes of Cerro Tute, Parque Nacional Cerro Tute, *Croat & Zhu 76879* (MO); 6.4 km outside of Santa Fe on road that passes the agricultural school, *Folsom 2961* (MO); Cerro Tute ridge up from former Escuela Agrícola, Santa Fe, *Hamilton & Dressler 3023* (MO); W of Alto de Piedras W of Santa Fé, *Hammel 4633* (MO); ridge of Cordillera de Tute, along trail to Cerro Tute, 3–4 km past Escuela Agrícola Alto de Piedra, just W of Santa Fe, *Knapp & Kress 4356* (MO, PMA); NW of Santa Fe, 10.8 km from Escuela Agrícola Alto de Piedra on road to Calovebora, *Mori 6724* (MO); ca. 15 km NW of Santa Fe, on road to Calovebora (Panama Hwy. 35) near Continental Divide, *Mori & Bolten 7668* (MO).

I. 20. Notopleura penduliflora C. M. Taylor, sp. nov. TYPE: Panama. Veraguas: Cerro Tute, ridge up from former Escuela Agrícola, Santa Fé, 08°35′N, 81°05′W, 800–1100 m, 15 July 1983, *C. Hamilton & K. Krager 3925* (holotype, MO-3646500; isotype, MO-4390373). Figure 6D, E.

Haec species a *Notopleura plagiantha* vagina stipulari bene evoluta appendicem interpetiolarem centralem conicam usque subcomplanatam gerente distinguitur.

Terrestrial, succulent, erect herbs or soft shrubs to 2 m tall, unbranched; stems glabrous. *Leaves* lanceolate to elliptic-oblanceolate, 7.5–15.5 × 2.5–4.5 cm, at apex acute to acuminate, at base acute to cuneate, drying papyraceous, adaxially glabrous, abaxially paler and glabrous or sparsely puberulous; secondary veins 8 to 11 pairs, not looping to interconnect, adaxially venation plane or costa sometimes thickened, abaxially costa prominent, secondary veins visible but plane, and remaining venation plane and not visible; *petioles* 0.6–2.5 cm long, glabrous; *stipules* glabrous, united around stem into a continuous sheath 1.5–3 mm long, truncate to rounded, deciduous with leaves, interpetiolarly with a succulent conical to triangular appendage 2–4 mm long, rather flattened, shortly fimbriate at apex, ascending, caducous, inserted medially or at base of sheath. *Inflorescences* pseudoaxillary, capitate to subcapitate, glabrous, strongly deflexed to pendulous, purple; peduncles 0.5–1 cm long; heads 1 per axil, cupuliform to hemispherical, 0.6–1 × 1–3 cm; external bracts 2, lanceolate to triangular, 10–15 mm long, acute to acuminate, remaining bracts triangular to ovate or linear, 6–10 mm long, acute, entire to ciliolate; *flowers* sessile; hypanthium not seen; *calyx limb* glabrous to puberulous, 3.5–4 mm long, lobed for ca. 3/4, lobes 5, narrowly triangular, acute to acuminate, ciliolate; *corolla* infundibuliform, white, externally glabrous, internally not seen, tube ca. 6 mm long, lobes 5, triangular, ca. 2 mm long, dorsally smooth; *anthers* not seen; *stigmas* 2, linear, ca. 1.5 mm long, situated in corolla throat. *Infructescences* similar to inflorescences; *fruits* obovoid, ca. 5 × 3.5 mm, glabrous, color not noted, with stipe to 1 mm long; *pyrenes* 2, hemispherical in cross section, with 3 to 4 weakly developed longitudinal ridges.

Habitat, distribution, and phenology. In wet and premontane forests at 600 to 1200 m in western Panama; collected in flower in March, June, and July, in fruit in July.

Notopleura pendulifora is distinguished by its stipules with well-developed sheaths bearing a conical to rather flattened interpetiolar appendage, its capitate nodding inflorescences with the two most external bracts better developed than the others, its calyx limbs 3.5–4 mm long, and its range in western Panama. The specific epithet refers to the nodding orientation of the inflorescences. This new species is similar to *N. plagiantha*; *N. plagiantha* differs from this new species in its stipules with the sheathing portion reduced or essentially absent and the appendage inserted terminally on the sheath and enlarged into a bilobed to erose lamina, and also in its erect to somewhat deflexed inflorescences with the bracts generally all equal in size.

Paratypes. PANAMA. **Veraguas:** Santa Fé, Serranía de Tute, *Galdames et al. 3074* (MO, PMA, SCZ); above Primero Brazo del Río Santa María, N of Escuela Agrícola Alto de Piedra, just W of Santa Fé, *Knapp & Dressler 5369* (MO); on Caribbean slope above Río Primero Brazo 5 mi. NW of Santa Fe, *Liesner 974* (MO, NY).

I. 21. Notopleura sanblasensis C. M. Taylor, sp. nov. TYPE: Panama. Panamá–San Blas: trail from end of road past Los Altos de Pacora region of Cerro Jefe on to Cerro Brewster, 9°17′N, 79°17′W, 20–25 Apr. 1985, *B. Hammel & G. de Nevers 13595* (holotype, MO-3616163). Figure 4C, D.

Haec species a *Notopleura capitata* foliorum venis secundariis 10- ad 12-jugatis atque limbo calycino 4.5–5.5 mm longo distinguitur.

Succulent, terrestrial, erect herbs or soft shrubs to 1.5 m tall, unbranched; stems glabrous. *Leaves* elliptic to obovate, 10–26 × 6.5–15 cm, at apex shortly acuminate with tips 5–15 mm long, at base cuneate to acute and often attenuate, drying membranaceous to papyraceous, adaxially glabrous, abaxially paler and glabrous; secondary veins 10 to 12 pairs, not looping to interconnect, adaxially venation plane or costa sometimes thickened, abaxially costa prominent, secondary veins prominulous, and remaining venation plane and invisible or rarely intersecondary veins visible; *petioles* 2–6.5 cm long, glabrous; *stipules* glabrous, shortly united around stem or to petioles, 1–3 mm long, rounded to triangular, caducous or persistent on distalmost 2 to 3 nodes, with 1 divergent, conical appendage 2–4 mm long, glabrous, caducous, entire, inserted medially to apically. *Inflorescences* pseudoaxillary, capitate, puberulous to hirtellous, deflexed to pendulous, pale green to white; peduncles 3–10 mm long; heads 1 per axil, hemispherical to subglobose, 1–1.5 cm diam.; bracts acute, entire, those external to the inflorescence lanceolate to ovate, 6–10 mm long, those subtending flowers narrowly triangular to linear, 4–8 mm long; *flowers* sessile to subsessile; hypanthium turbinate, ca. 0.8 mm long, glabrous; *calyx limb* glabrous, 4.5–5.5 mm long, divided nearly to base, lobes 5, narrowly triangular, acute, often falcate, entire; *corolla, anthers,* and *stigmas* not seen. *Infructescences* similar to inflorescences or becoming purple; *fruits* ellipsoid, 5–7 × 4–5 mm, glabrous, white, with stipes to 2 mm long; pyrenes 2, strongly dorsiventrally flattened, with 1 sharp central ridge and markedly thickened margins.

Habitat, distribution, and phenology. In wet forest at 200 to 800 m on Caribbean slopes in eastern Panama; collected in fruit in March, August, and December.

Notopleura sanblasensis is distinguished by the combination of its sheathing stipules with a succulent divergent appendage on each side, its capitate, shortly pedunculate inflorescences with acute bracts, its calyx limbs 4.5–5.5 mm long and divided nearly to the base into relatively narrow lobes, its white fruits, and its strongly dorsiventrally flattened pyrenes with the keel and margins thickened. The specific epithet refers to the geographic distribution, which is apparently limited to the San Blas region. This new species is similar to *N. capitata,* described above; *N. capitata* differs from *N. sanblasensis* by its 10 to 17 pairs of secondary leaf veins that often loop to interconnect at least in the distal part of the leaf blade and its calyx limbs 1.5–2.5 mm long.

Paratypes. PANAMA. **San Blas:** mountains above Puerto Obaldía, *Gentry 1492A* (MO); Cordillera de San Blas, límite San Blas, trocha de Masargandi, *H. Herrera & González 1334* (MO); caminando por el filo desde una quebrada del Río Diablo hacia la Cordillera de Ibedón, *Herrera et al. 1488* (MO, PMA); trail from El Llano to Cartí–Tupile, *Kennedy 2578* (MO).

I. 22. Notopleura spiciformis C. M. Taylor, sp. nov. TYPE: Ecuador. Esmeraldas: San Lorenzo, Reserva Etnica Awá, Centro Guadualito, 1°15′N, 78°40′W, 80 m, 20–29 July 1992, *C. Aulestia, G. Tipaz, L. Delgado & G. Lao 20* (holotype, QCNE; isotype, MO-4890101). Figure 5E, F.

Haec species a congeneris vagina stipulari bene evoluta appendicem interpetiolarem succulentam bene evolutam gerente, pedunculo satis longo ut videtur in quoque caule solitario, inflorescentiae axe congesto satis brevi, corollae infundibuliformis lobulis abaxialiter incrassatis, fructu

albo atque pyrenarum dorsiventraliter complanatarum porcis dorsalibus longitudinalibus 3 ad 5 distinguitur.

Erect, terrestrial, succulent herbs or soft shrubs to 3 m tall, unbranched; stems glabrous to puberulous. *Leaves* elliptic, 12–26 × 5–9.5 cm, at apex obtuse to usually acute or somewhat acuminate, at base acute to cuneate, drying membranaceous to papyraceous, adaxially glabrous to puberulous, abaxially puberulous to glabrescent and usually paler; secondary veins 10 to 23 pairs, loosely to markedly looping to interconnect at least in distal part of blade, adaxially costa prominent and remaining venation plane, abaxially costa prominent, secondary veins prominulous, and remaining venation plane and invisible or intersecondary veins frequently well-developed; margins entire, plane; *petioles* 1–4 cm long, glabrous to puberulous; *stipules* glabrous, sheath 2–3 mm long, truncate to broadly rounded, caducous, interpetiolarly with a succulent, divergent appendage 2.5–4 mm long, inserted medially or above medially, conical, caducous, at apex glandular and 3–4-fimbriate. *Inflorescences* pseudoaxillary and apparently 1 per stem, green, ascending, densely puberulous to hirtellous; peduncles 6–16 cm long, flexuous; branched portion cylindrical-spiciform to subglobose, 1.5–3.5 × 1.5–2.5 cm, secondary axes 2 to 3 pairs, relatively short, terminating in congested dichotomous cymules; bracts entire, those subtending primary axes narrowly triangular to narrowly ligulate, 3.5–10 mm long, those subtending flowers deltoid to ovate, 1.5–2.5 mm long; *flowers* sessile or subsessile in glomerules of 3 to 7; hypanthium turbinate, ca. 1 mm long, densely puberulous; *calyx limb* densely puberulous, 0.8–1.2 mm long, 5-lobed for 1/4–1/2 its length, lobes triangular; *corolla* slenderly funnelform, white, externally densely puberulous, internally glabrous except hirtellous at stamen attachment, tube ca. 3.5 mm long, lobes 5, ca. 2 mm long, narrowly ligulate, acute, abaxially with a linear appendage ca. 1 mm long; *anthers* ca. 1.2 mm long, situated just above middle of corolla tube; *stigmas* 2, ca. 1 mm long, exserted. *Infructescences* similar to inflorescences or sometimes with axes becoming developed and monochasial; *fruits* obovoid, 6–7 × 4–4.5 mm long, glabrous, white; *pyrenes* 2, dorsiventrally flattened, dorsally with 3 to 5 rounded longitudinal ridges and margins thickened and similar to ridges.

Habitat, distribution, and phenology. In wet forest at 0 to 1150 m, western Colombia to northwestern Ecuador; collected in flower in July and September through November, in fruit in February, April, and November.

Notopleura spiciformis is distinguished by the combination of its stipules with a well-developed sheath bearing a well-developed, succulent, interpetiolar appendage; its relatively long peduncles that are apparently solitary on each stem; its congested, relatively short secondary inflorescence axes; its funnelform corollas with the lobes with a linear abaxial appendage; its white fruits; and its pyrenes that are dorsiventrally flattened and dorsally have 3 to 5 longitudinal ridges. The specific epithet refers to the form of the inflorescences of most specimens. This new species is similar to *N. anomothyrsa* and *N. longipedunculoides*. In particular these species all share well-developed peduncles, generally cylindrical-spiciform inflorescences, and dorsiventrally flattened pyrenes with 3 to 5 low dorsal ridges. However, *N. anomothyrsa* differs from *N. spiciformis* in having several peduncles per stem, relatively more elongated and branched inflorescence axes, and corolla lobes that abaxially have only a short thickenening, up to 0.5 mm long; *N. longipedunculoides* differs from *N. spiciformis* in its stipules with expanded, ovate to elliptic or oblong, interpetiolar laminas 5–20 mm long.

Paratypes. COLOMBIA. **Chocó:** Nóvita, ladera N del Cerro Torrá, Alto del Oso, *E. Forero et al. 3267* (COL, MO); hoya del Río San Juan, alrededores de Docordó, *E. Forero et al. 4319* (COL, MO); región del Río Pichimá, comunidad indígena Waunana, *L. Forero 653* (COL, MO), *683* (COL, MO). **Nariño:** Ricaurte, vicinity of Ricaurte, along Río Imbí, ca. 2–3 km above Ecopetrol Campamento Palmar, located 3 km NW of Ricaurte along trail to Ramos, *Croat 71572* (MO); just N of Pimbí, 15 km E of Barbacoas, *Fosberg 21225* (US)., **Valle del Cauca:** Buenaventura, Córdoba, San Cipriano, Reserva Natural Río Escalerete, *C. M. Taylor et al. 12139* (MO, TULV). ECUADOR. **Carchi:** trail along plain above Tobar Donoso and to Río Guape, *Hoover 1184* (MO); border area between Carchi and Esmeraldas, ca. 7 km past Lita on road Lita–Alto Tambo, *van der Werff et al. 12081* (MO). **Esmeraldas:** San José, Km 321 along railroad from Ibarra to San Lorenzo, *Boom 1317* (MO); San Lorenzo, Reserva Indígena Awá, parroquia Ricaurte, comunidad Balsareño, Río Palabí, *D. Rubio & Quelal 1454* (MO, QCNE).

I. 23. Notopleura torrana C. M. Taylor, sp. nov. TYPE: Colombia. Chocó: San José del Palmar, Cerro del Torrá, vertiente oriental, mesa abajo de la cumbre, 2500–2550 m, 14 Aug. 1988, *P. A. Silverstone-Sopkin, N. Paz, R. T. González, J. E. Ramos, L. H. Ramos & A. Henao 4395* (holotype, CUVC-23463; isotypes, F-2131010, MO-4342394). Figure 2A, B.

Haec species a congeneris foliorum marginibus valde incrassatis ac venis secundariis non vel vix manifestis, stipulis triangularibus, inflorescentia pedunculata capitata subcapitatave, bracteis floralibus bene evolutis atque limbo calycino 2–2.5 mm longo distinguitur.

Creeping or climbing, terrestrial, succulent herbs; stems to 1.2 m long, glabrous to densely papillose-puberulous. *Leaves* lance-elliptic to elliptic-oblanceolate, 3–5.5 × 1–3 cm, at apex acute to acuminate, at base cuneate to obtuse, drying chartaceous, adaxially glabrous, abaxially markedly paler and glabrous; secondary veins not visible or infrequently weakly visible adaxially, 5 to 8 pairs, extending to unite with margins, adaxially venation plane, abaxially venation plane or costa sometimes prominulous; margins markedly thickened; *petioles* 2–15 mm long, glabrous to densely puberulous; *stipules* glabrous, interpetiolar, triangular to broadly triangular, 1.5–2.5 mm long, persistent, at apex acute and glandular. *Inflorescences* pseudoaxillary, capitate or subcapitate; peduncles 3–22 mm long, densely puberulous to hirtellous; heads 1 per leaf axil, hemispherical, 8–12 mm diam.; bracts triangular to lanceolate, 4–6 mm long, acute to acuminate, glabrous; *flowers* sessile; hypanthium turbinate to cupuliform, ca. 0.8 mm long, glabrous; *calyx limb* glabrous, 2–2.5 mm long, lobed nearly to base, lobes 5, narrowly triangular, acute, entire; *corolla* infundibuliform, white, externally glabrous, internally glabrous except hirtellous at stamen insertion, tube ca. 4 mm long, lobes 5, ca. 2 mm long, lanceolate to triangular, dorsally smooth; *anthers* ca. 1 mm long, situated in upper part of corolla throat; *stigmas* 2, linear, ca. 0.8 mm long, shortly exserted. *Infructescences* similar to inflorescences; *fruits* narrowly ellipsoid, ca. 4.5 × 2 mm, white, glabrous; *pyrenes* 2, hemispherical in cross section, dorsally smooth.

Habitat, distribution, and phenology. In wet montane forest at 2400–2550 m on the Cerro del Torrá and Cerro del Inglés in the Cordillera Occidental of the Andes in central Colombia; collected in flower January, August, and December, in fruit in August.

Notopleura torrana is distinguished by the combination of its leaves with the margins markedly thickened and the secondary veins invisible or only very weakly visible, its triangular stipules, its capitate or subcapitate pedunculate inflorescences with well-developed bracts, and its calyx limbs 2–2.5 mm long. This new species is similar to *N. macropodantha* of the Cordillera Oriental of northeastern Colombia, and has been confused with this species (e.g., Silverstone-Sopkin & Ramos-Pérez, 1995). However, *N. macropodantha* differs from this new species in its leaves with the secondary veins clearly visible and not extending to the margins, and its bilobed stipule appendages. *Notopleura torrana* is also similar to the sympatric species *N. biloba* (described previously in this article); *N. biloba* differs from *N. torrana* in its stipules that are flattened and laminar in form with two well-developed, usually persistent, non-glandular lobes, along with its subcapitate to shortly branched inflorescences. The species epithet refers to the type locality. The Cerro del Torrá is a relatively isolated massif in the Chocó biogeographic region and has an unusual flora (Silverstone-Sopkin & Ramos-Pérez, 1995). *Notopleura torrana* is included in the "*Notopleura macropodantha* group" discussed in the introductory part of this article.

Paratypes. COLOMBIA. **Chocó:** San José del Palmar, Cerro del Torrá, vertiente nororiental, plan grande abajo de la cumbre, *Silverstone-Sopkin et al. 1782* (CUVC, MO). **Valle del Cauca:** El Cairo, Cerro del Inglés (Cordillera Occidental, Serranía de los Paraguas, a 1 hora en jeep de El Cairo), *Silverstone-Sopkin et al. 2786* (CUVC, MO).

I. 24. Notopleura tubulistipula C. M. Taylor, sp. nov. TYPE: Ecuador. Cotopaxi: carretera Latacunga–Zumbahua–Pilaló, 00°58′S, 78°53′W, 2800–3100 m, 22 May 1988, *W. Palacios, D. Neill & C. Cerón 2550* (holotype, MO-5568185). Figure 1A, B.

Haec species a *Notopleura aggregata* vagina stipulari tubulari bene evoluta appendicem interpetiolarem laminarem leviter usque profunde bilobam gerente, limbo calycino ca. 4 mm longo atque tubo corollino ca. 14 mm longo distinguitur.

Erect, succulent, terrestrial herbs or soft shrubs to 1 m tall, unbranched; stems glabrous. *Leaves* elliptic to elliptic-oblong or oblanceolate, 10–18 × 5–6 cm, at apex acute to shortly acuminate, at base cuneate to obtuse, drying papyraceous to membranaceous, adaxially glabrous, abaxially paler and densely hirtellous to glabrescent or usually remaining hirtellous on principal veins; secondary veins 12 to 15 pairs, looping to interconnect in well-developed submarginal veins, adaxially venation plane, abaxially costa prominent, secondary veins prominulous, and remaining venation plane and not visible or occasionally with short intersecondaries visible; margins plane; *petioles* 1.5–4 cm long; *stipules* with sheaths tubular, 3–7 mm long, glabrous, truncate, persisting on distalmost 2 to 3 nodes, with interpetiolar appendage laminar, oblong to ligulate or ovate, 3–6 mm long, hirtellous to glabrous, ciliolate with the projections apparently sometimes glandular, caducous, drying membranaceous, bilobed shortly or up to 3/4, inserted medially on the sheath then extending downward on each side, the line of insertion forming a "V." *Inflorescences* pseudoaxillary, borne with and below the leaves, paniculate, ascending, green, puberulous to glabrescent;

peduncles 3–9 cm long; branched portion pyramidal, 3–5 × 3–6 cm, with developed secondary axes produced at 1 node, 2 per node, terminating in glomerules or congested cymules; bracts entire, acute, those subtending secondary axes narrowly triangular to lanceolate, 3–10 mm long, those subtending flowers ovate, 5–7 mm long; *flowers* sessile or subsessile in glomerules or congested cymules of 3 to 7; hypanthium turbinate, ca. 0.8 mm long, glabrous to hirtellous; *calyx limb* ca. 4 mm long, glabrous, 5-lobed for 3/4 or more, lobes narrowly triangular, acute, ciliolate; *corolla* slenderly funnelform, white to yellow, externally glabrous, internally glabrous except hirtellous near middle, tube ca. 14 mm long, lobes 5, ca. 2 mm long, triangular, abaxially smooth or a little thickened; *anthers* ca. 1.5 mm long, included, situated a little below top of corolla tube; *stigmas* 2, linear, 1.5–2 mm long, included, situated by or just below anthers. *Infructescences* similar to inflorescences; *fruits* ellipsoid to subglobose, 6–7 × 4.5–5 mm, white, hirtellous to glabrous, sessile or subsessile; *pyrenes* 2, dorsiventrally strongly flattened, dorsally with 1 sharp, central, longitudinal ridge and often also with 2 lateral, similar but smaller ridges, margins thickened, rounded to somewhat sharp.

Habitat, distribution, and phenology. In wet montane forest at 2300 to 3020 m in Andean Ecuador; collected in flower in March, May, September, and December, in fruit in March and May.

Notopleura tubulistipula is distinguished by its stipules with the sheaths well-developed and the interpetiolar appendages laminar and shortly to deeply bilobed, its relatively well-developed bracts, its calyx limbs ca. 4 mm long, its corolla tubes ca. 14 mm long, its white fruits, and its dorsiventrally flattened pyrenes with 1 or 3 dorsal ridges. The stipules are distinctive in their combination of well-developed tubular sheaths with the delicate, laminar, usually deeply bilobed interpetiolar appendage; the specific epithet refers to the tubular stipule sheath. *Notopleura tubulistipula* is similar in general aspect to *N. biloba*, *N. macropodantha*, and *N. longiflora* of Andean Colombia. All of these Colombian species differ from *N. tubulistipula* in their stipule sheaths that are 2.5 mm long or shorter, triangular, and interpetiolar or united to the petioles. The few flowers studied appear to be monomorphic, with both stigmas and anthers included. *Notopleura tubulistipula* is included in the "*Notopleura aggregata* group" discussed in the introductory part of this article.

Paratypes. ECUADOR. **Cotopaxi:** Cordillera Occidental, Pilaló, *Acosta S. 14752* (F). **Napo:** Quijos, Sierra Azul (Agrícola Industrial Río Aragón), *A. Alvarez et al. 385* (MO, QCNE); Archidona, Sumaco Napo-Galeras National Park, Sumaco Mountain, *J. L. Clark 2243* (MO, QCNE); Reserva Ecológica Cayambe-Coca, 5 km de Cuyuja, camino a Quito, *Gavilanes & Castellanos 609* (AAU); upper slopes and summit of Guagra Urcu, *Holm-Nielsen et al. 27167* (AAU), *Holm-Nielsen et al. 27237* (AAU), *Holm-Nielsen et al. 27470* (AAU), *Holm-Nielsen et al. 27605* (AAU); upper Río Suno, near Guagra Urcu, *Holm-Nielsen et al. 27503* (AAU), *Holm-Nielsen et al. 27532* (AAU), *Holm-Nielsen et al. 27551* (AAU). **Pichincha:** Cerro Pugsi, NW slope of Volcán Pichincha, *Bleiweiss 1136* (NY); Tandacato, *Heilborn 496* (S). **Tungurahua:** Cordillera de Llanganates, valley of Río Sangarinas (Desaguadero), *Asplund 9792* (S).

I. 25. Notopleura zarucchiana C. M. Taylor, sp. nov. TYPE: Colombia. Antioquia: Sonsón, Los Cristos, sitios "Páramo de Sonsón" y "Monumento," sobre la cuchilla "Comadrejal," 10 km SE de Sonsón en la vía al Nariño, 05°38′N, 75°15′W, 2500–2740 m, 17 Aug. 1992, *R. Callejas & F. J. Roldán 10511* (holotype, HUA-83070). Figure 2F–H.

Haec species a congeneris foliorum venis secundariis cum marginibus incrassatis conjunctis ac venatione tertiaria abaxialiter manifesta, inflorescentia cymosa congesta, calycis limbo 2–3.5 mm longo atque corollae extus hirtellae tubo 10–12 mm longo distinguitur.

Succulent, terrestrial herbs or soft shrubs to 0.8 m tall, unbranched or apparently little-branched; stems densely hirtellous. *Leaves* lanceolate to ovate, 3.5–7 × 1.5–4 cm, at apex acute, at base cuneate to obtuse or subtruncate, drying papyraceous to chartaceous, adaxially densely pilosulous to subfloccose, abaxially paler and glabrous except strigillose to hirtellous on principal veins; secondary veins 6 to 10 pairs, extending to unite with margins, adaxially venation plane, abaxially costa prominent, secondary veins prominulous, and reticulated tertiary venation visible and often thickened; margins markedly thickened, narrowly winged; *petioles* 3–22 mm long, densely hirtellous; *stipules* glabrous, interpetiolar or shortly united around stem, broadly triangular, 2–3 mm long, succulent, persistent, at apex with 2–5 linear glands 0.3–1 mm long, caducous. *Inflorescences* pseudoaxillary, congested-cymose, hirtellous, ascending; peduncles 1.5–4 cm long; branched portion rounded-corymbiform to hemispherical, 1–1.5 × 0.8–2.5 cm (without corollas), with 1 pair of short secondary axes; bracts narrowly triangular, 6–15 mm long, acute, glabrous; pedicels 0–1 mm long; *flowers* subsessile to shortly pedicellate in glomerules or congested cymules; hypanthium turbinate, ca. 1 mm long, glabrous; *calyx limb* glabrous, 2–3.5 mm long, divided for 2/3–3/4, lobes 4 to 5, narrowly triangular, acute; *corolla* infundibuliform, white, externally

sparsely to moderately hirtellous, internally glabrous, tube 10–12 mm long, lobes 4 or 5, 3.5–5 mm long, ligulate, dorsally smooth; *anthers* ca. 1.2 mm long, situated just above middle of corolla tube; *stigmas* ca. 0.8 mm long, situated in corolla throat. *Infructescences* and *fruits* not seen.

Habitat, distribution, and phenology. In wet premontane and montane forests at 1700 to 3300 m in the Cordilleras Occidental, Central, and Oriental of Colombia; collected in flower February through June and August.

Notopleura zarucchiana is distinguished by the combination of its leaves with the secondary veins uniting with the thickened margins and the tertiary venation visible abaxially, its congested-cymose inflorescences, its calyx limbs 2–3.5 mm long, its externally hirtellous corollas, and its corolla tubes 10–12 mm long. The species epithet honors James L. Zarucchi, an American botanist who among other accomplishments has documented the Colombian flora with excellent specimens. Several other montane Colombian species of *Notopleura* also have thickened leaf margins, notably *N. macropodantha*, but only *N. longiflora* (described above) also has similarly long corollas. *Notopleura longiflora* differs from *N. zarucchiana* in its calyx limbs 5–7.5 mm long and corollas externally glabrous to sparsely puberulous with tubes 12.5–14 mm long; *N. macropodantha* differs from *N. zarucchiana* in its adaxially glabrous leaves with the secondary veins not extending all the way to the margins, its stipules with two well-developed lobes, its corolla tubes 3–4 mm long, and its corolla lobes ca. 1.5 mm long. *Notopleura zarucchiana* is included in the "*Notopleura macropodantha* group" discussed in the introductory part of this article.

Paratypes. COLOMBIA. **Antioquia:** Sonsón, San Pablo, vía Sonsón-Nariño, 13.3 km SE de Sonsón, *Callejas et al. 6311* (HUA); along old camino "Páramo de Sonsón" along or near carretera between Sonsón and Nariño, *Core 741* (US); 10 km al E de Sonsón, *Scolnik et al. 19An237* (US). **Cundinamarca:** subida al Alto de Tibre, *F. O. Zuloaga 4045* (COL). **Risaralda:** Santuario, Las Colonias, 200 m abajo del "Reposo," Macizo de Tamaná, *J. H. Torres et al. 1574* (COL p.p., plant "B").

II. Notopleura subg. **Viscagoga** (Baillon) C. M. Taylor, Ann. Missouri Bot. Gard. 88: 511. 2001. *Uragoga* sect. *Viscagoga* Baillon, Adansonia 12: 227. 1879. *Psychotria* ser. *Viscagoga* (Baillon) Steyermark, Mem. New York Bot. Gard. 23: 566. 1972. TYPE: *Notopleura guadalupensis* (DC.) C. M. Taylor.

This subgenus comprises 15 species (including the 5 described in this article), which are recognizable by their epiphytic, usually branched habit, terminal and sometimes also pseudoaxillary inflorescences, and pyrenes 2 to 6. Plants of subgenus *Viscagoga* have stipules with a truncate sheath and one to several short glandular interpetiolar appendages, or in a few species these are apparently lacking. Species of subgenus *Viscagoga* are found generally throughout the range of *Notopleura*, which is expanded here with the discovery of *N. bahiensis* C. M. Taylor.

II. 1. Notopleura bahiensis C. M. Taylor, sp. nov. TYPE: Brazil. Bahia: Uruçuca, Parque Estadual Serra do Condurú, trail to summit of Cerro do Condurú, Southern Bahian Wet Forest, 14°29′S, 39°06′W, 210 m, 28 Sep. 2001, *W. W. Thomas, J. Jardim, S. Sant'Ana & F. Junchum 12166* (holotype, CEPEC; isotypes, MO-5568186, NY).

Haec species a *Notopleura multiramosa* fructus pyrenis 4 ad 6 atque distributione disjuncta orientali-brasiliensi distinguitur.

Succulent suffrutescent herbs, epiphytic, to 2 m tall; stems glabrous. *Leaves* elliptic to lance-elliptic or oblanceolate, 3–9.5 × 1–3.5 cm, at apex acute, at base acute to obtuse, glabrous, when dry subcoriaceous; secondary and higher-order venation not visible; *petioles* 3–7 mm long; *stipules* glabrous, united around stem into a truncate tubular sheath 1.5–2.5 mm long, near base of interpetiolar portion with a conical appendage 0.5–1 mm long, at apex this glandular, sheath generally persistent, appendage generally persistent but becoming dry and indurated. *Inflorescences* terminal, glabrous or with higher-order axes sometimes puberulous, cymose, color not noted; peduncles 0.8–1.2 cm long; branched portion 1.5–4 × 2–6 cm, rounded-corymbiform, with secondary axes 1 to 2 pairs; bracts deltoid, 0.3–1 mm long; pedicels 0.5–2 mm long; *flowers* pedicellate in dichasial cymules of 3(5); hypanthium ellipsoid, ca. 1 mm long, densely puberulous; *calyx limb* densely puberulous, 0.3–0.5 mm long, truncate; *corolla* in bud externally puberulous, mature *corolla, anthers,* and *stigmas* not seen. *Fruits* ellipsoid to subglobose, ca. 4 × 4 mm, glabrescent, orange; *pyrenes* 4, dorsally smooth.

Habitat, distribution, and phenology. In wet forests in Bahia, eastern Brazil, at 500 to 760 m; collected in flower bud in June, in fruit in March, May, and September.

Notopleura bahiensis is apparently disjunct in its distribution from other *Notopleura* species; the species epithet refers to its geographic distribution. The species of *Notopleura* with the geographical

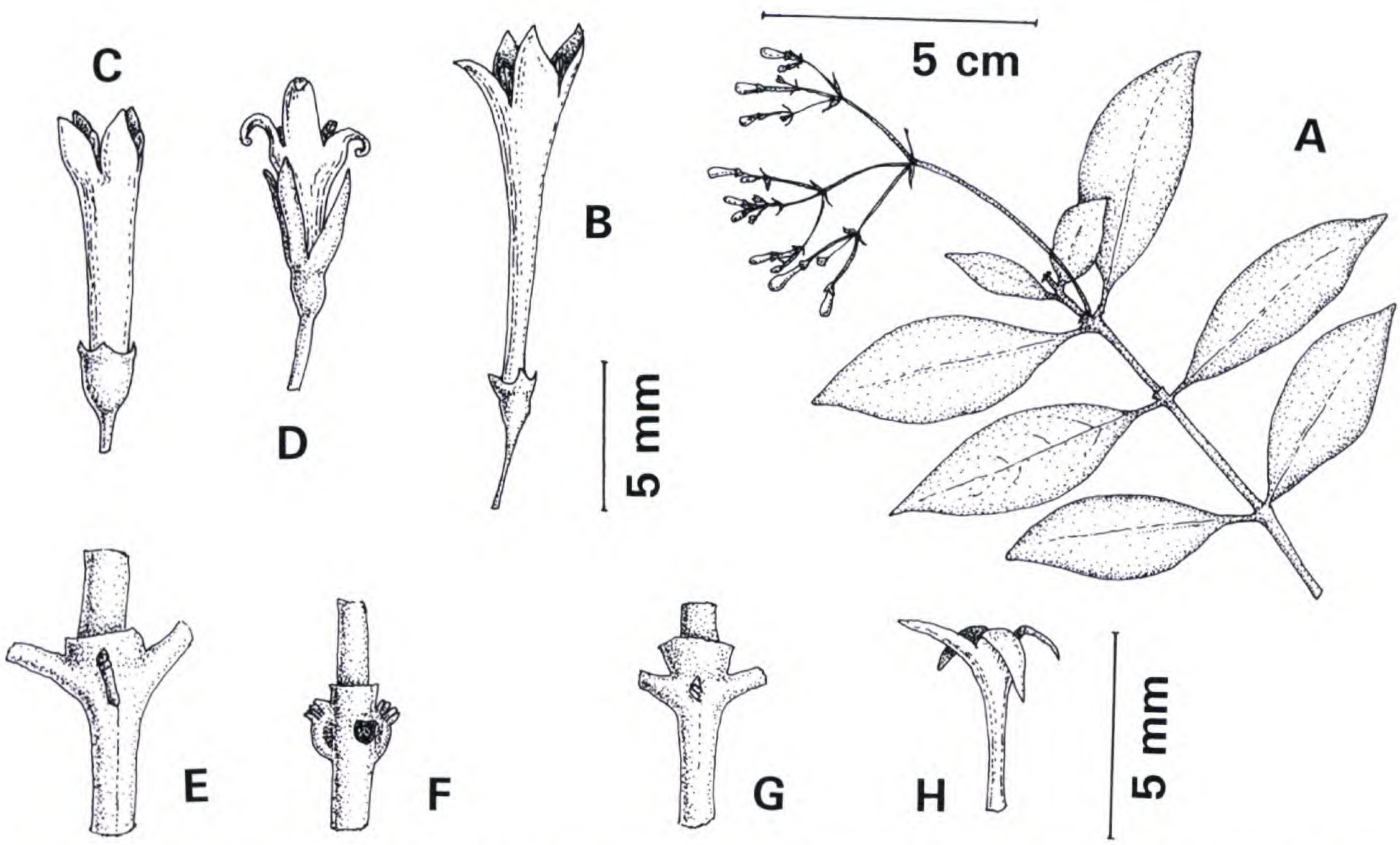

Figure 7. New species of *Notopleura* subg. *Viscagoga*. A, B, *Notopleura elegans* C. M. Taylor. —A. Stem with leaves and inflorescence; based on *Boyle 928* (MO). —B. Flower; based on *Lent 2056* (MO). —C. *Notopleura vargasiana* C. M. Taylor, flower; based on *Werner 275* (MO). D–F, *Notopleura cocleensis* C. M. Taylor. —D. Flower; based on *Knapp et al. 5999* (MO). —E. Stem node (same node as in F) with stipule and basal portions of petioles, interpetiolar view; based on *Croat 37446* (MO). —F. Same stem node as in E, intrapetiolar view with petiole removed. G, H, *Notopleura episcandens* C. M. Taylor & D. H. Lorence; based on *Knapp et al. 4506* (MO). —G. Stem node with basal portions of petioles. —H. Corolla. C, D, E, F, G, H to same scale.

range closest to this new species is *N. multiramosa* of the Guianas, which is similar to *N. bahiensis* in general aspect and in having truncate calyx limbs. In addition to their geographical separation, *N. multiramosa* differs morphologically from *N. bahiensis* in its fruits with consistently two pyrenes. There may be differences in floral morphology as well, but the flowers of both species are poorly known. The fruits are described on a few collections as orange, but it is possible that these later become red then black at maturity as in several other epiphytic species of *Notopleura*.

Paratypes. BRAZIL. **Bahia:** São José da Vitória, ca. 9 km na estrada S. José–Una, ramal a dereita ca. 3 km adentro, *A. M. de Carvalho et al. 6499* (NY); Rod. Rio Branco a Una, *R. S. Pinheiro 1349* (US); estrada São José, Una, Km 8, ramal a dereita a partir de São José, *A. M. Amorim et al. 1689* (MO); Una, riberão das Palmeiras, Serra Javi, ramal com entrada no km 11 da rodovia São José/Una, lado S a 9 km âte cima da Serra, 9 km por ar SE São José, *L. A. Mattos da Silva & Judziewicz 4154* (US); Uruçuca, 7.4 km N of Serra Grande on road to Itacaré, Fazenda Lagoa do Conjunto Fazenda Santa Cruz, *W. W. Thomas et al. 10907* (MO, NY).

II. 2. Notopleura cocleensis C. M. Taylor, sp. nov. TYPE: Panama. Coclé: slopes and summit of Cerro Gaital, N of El Valle, 8°40′N, 80°07′W, 1000–1400 m, 10 July 1982, *S. Knapp, J. Mallet & R. Dressler 5999* (holotype, MO-3032258). Figure 7D–F.

Haec species a congeneris foliorum ellipticorum 1.2–4.5 × 0.5–2 cm venis secundariis non manifestis, pedunculo 0.5–1.2 cm longo, stipularum appendicibus glandularibus pluribus 0.5–1 mm longis, calycis limbo 1.5–3 mm longo, corollae tubo ca. 3 mm longo ac lobulis ca. 1.5 mm longo atque fructu nigro distinguitur.

Epiphytic, succulent suffrutescent herbs or shrubs to 0.3 m tall; stems glabrous. *Leaves* elliptic to elliptic-oblong, 1.2–4.5 × 0.5–2 cm, at apex acute and shortly apiculate, at base acute to cuneate, glabrous, when dry coriaceous, slightly to markedly discolorous; secondary veins not or almost not evident; *petioles* 2–4 mm long, winged for most or all of their length; *stipules* glabrous, united around stem into a tubular truncate sheath 0.8–1.5 mm long, interpetiolar portion near base with a medial cartilaginous rib terminating at middle of sheath in a group of

caducous, glandular appendages 0.5–1 mm long. *Inflorescences* terminal and pseudoaxillary, glabrous, paniculate; peduncles 0.5–1.2 cm long; branched portion 1 × 1.5–2.5 cm, corymbiform, with secondary axes 1(2) pair, bracts 1.5–7 mm long, linear, acute, those subtending flowers 1.5–3 mm long; pedicels 1.5–3 mm long; *flowers* pedicellate in cymules of 3 to 5; hypanthium ellipsoid, ca. 0.8 mm long, glabrous; *calyx limb* 1.5–3.5 mm long, glabrous, red, deeply lobed, lobes 4, ligulate, acute to acuminate; *corolla* funnelform, white to pink, externally glabrous, internally glabrous except hirtellous in a ring situated near middle of tube, tube ca. 3 mm long, lobes 4, triangular, ca. 1.5 mm long, dorsally smooth; *anthers* ca. 1 mm long, partially exserted; *stigmas* ca. 1 mm long, exserted. *Fruits* subglobose, ca. 4.5 mm diam., glabrous, red then black; *pyrenes* 4, dorsally smooth or usually with a weak central ridge.

Habitat, distribution, and phenology. Western Panama, in wet forest and cloud forest at 800 to 1400 m, collected in flower in March, July, and December, in fruit in March and July.

Notopleura cocleensis is known only from Coclé Province, Panamá, and the specific epithet refers to this distribution. It is similar to *N. maxonii*, *N. elegans* (described below), *N. guadalupensis*, and *N. episcandens* (described below). *Notopleura maxonii* is sympatric with *N. cocleensis*, and can be distinguished from it by its calyx limb 0.8–1 mm long and its leaves 0.7–2.5 × 0.2–0.8 cm; *N. elegans* is also sympatric with *N. cocleensis*, and can be distinguished from it by its calyx limbs 0.8–1.8 mm long and corolla tubes 6–10 mm long; *N. episcandens* from eastern Panama can be distinguished from *N. cocleensis* by its ovate to elliptic-lanceolate leaves and solitary triangular interpetiolar appendages; and *N. guadalupensis* is sympatric with *N. cocleensis* and can be distinguished from it by its ovate to lanceolate leaves and calyx limbs 0.5–0.8 mm long.

Paratypes. PANAMA. **Coclé:** La Mesa, above El Valle de Antón, ca. 2 km W of Cerro Pilón, *Croat 37446* (MO); 3-mountain ridge above El Valle, *C. Hamilton et al. 4148* (MO); foothills and summit of Cerro Caracol, near La Mesa N of El Valle de Antón, *Knapp 1114* (MO); Cerro Caracol, *Kirkbride 1108A* (MO p.p., plant labeled B); divide SW of La Mesa at end of logging road, *Stein & Hamilton 1009* (MO); ridge from summit of Cerro Carocoral [sic; Caracol] to summit of Cerro Gaital, N rim of El Valle, *Sytsma 3826* (MO).

II. 3. Notopleura elegans C. M. Taylor, sp. nov. TYPE: Costa Rica. Heredia: Parque Nacional Braulio Carillo, sendero de transecto, on flat portion of ridge during descent from Cerro las Marías to old road from San Rafael, Vara Blanca to Refugio at 2070 m, 10°10′07″N, 84°06′48″W, 2210–2240 m, 5 June 1992, *B. Boyle 928* (holotype, MO-3294927; isotypes, CR, INB). Figure 7A, B.

Haec species a *Notopleura guadalupensi* limbo calycino 0.8–1.8 mm longo atque tubo corollino 6–10 mm longo distinguitur.

Epiphytic, succulent shrubs and suffrutescent herbs to 1 m tall; stems glabrous. *Leaves* elliptic, 1.2–5.2 × 0.7–2.8 cm, at apex acute to somewhat acuminate, at base acute to cuneate, glabrous, when dry chartaceous to subcoriaceous, slightly to markedly discolorous; secondary veins not evident; *petioles* 2–8 mm long; stipules glabrous, united around the stem into a truncate, tubular sheath 1–1.5 mm long, interpetiolar portion with 1 to 2 triangular, caducous, glandular appendices 0.5–1 mm long. *Inflorescences* terminal and pseudoaxillary, glabrous, paniculate, pink to red; peduncles (1.5)2–4.5 cm long; branched portion 2–4 × 2–5 cm, corymbiform to broadly triangular, with secondary axes 1 to 3 pairs; bracts linear, 1–6 mm, acute, those subtending flowers 1–3 mm long; pedicels 1–5 mm long; *flowers* pedicellate in cymules of 2 to 3; hypanthium ellipsoid, ca. 1 mm long, glabrous; *calyx limb* 0.8–1.8 mm long, glabrous, lobed for 1/2–deeply, lobes 4, triangular, acute; *corolla* slenderly funnelform, white sometimes tinged with blue, externally and internally glabrous, tube 6–10 mm long, lobes 4, 1.5–2.5 mm long, triangular, dorsally smooth; *anthers* ca. 1.2 mm long, partially exserted; *stigmas* ca. 0.2 mm long, exserted. *Fruits* subglobose, ca. 4 mm diam., glabrous, orange to red; *pyrenes* 4, dorsally smooth.

Habitat, distribution, and phenology. Northern Costa Rica and western Panama, in wet forest, oak forest, and cloud forest at 900 to 2482 m; collected in flower in January, March, and May through October, in fruit in January, March, April, June, July, and September through November.

Notopleura elegans is similar to *N. guadalupensis*, *N. cocleensis*, *N. pithecobia* (Standley) C. M. Taylor, and *N. vargasiana* (described below). *Notopleura guadalupensis* and *N. pithecobia* differ from *N. elegans* in their shorter calyx limbs, 0.5–1 mm long, and shorter corolla tubes, ca. 3 mm long; *N. cocleensis* differs from *N. elegans* in its calyx limbs 1.5–3 mm long and its corolla tubes ca. 3 mm long. The distinctions between *N. elegans* and

N. vargasiana are discussed under this latter species, below. The specific epithet of this new species refers to the graceful inflorescences with relatively well-developed pedicels and corollas.

Paratypes. COSTA RICA. **Alajuela:** near Quebrada Desengaño, 1 km E of Vara Blanca, *Lent 2056* (MO). **Cartago:** near and along crest of ridge S of Alto Patillos (and a continuation of the latter), ca. 6 km SE of Tapantí, *Grayum & Herrera 7717* (MO). **Guanacaste:** Estación Cacao, Parque Nacional Guanacaste, *R. Espinoza 77* (MO); trail to Cerro Cacao from Estación Biológica Cacao, *Short et al. 85* (BM). **Heredia:** N end of Cerros Las Marías, N slope of Volcán Barva, *Grayum 7282* (MO); headwaters of Río Santo Domingo, ca. 3 km E of San Rafael de Vara Blanca, N slope of Volcán Barba, *Grayum 7336* (BM). **Limón:** Talamanca, Quebrada Kuisa, trail up of camp [sic], ca. 500 m, Cordillera de Talamanca, *Bittner 1801* (MO). **Puntarenas:** Monteverde Reserve, Nuboso Trail, *Haber 510* (MO), *Haber ex Bello 2232* (MO); Monteverde Reserve, *Haber 533* (MO); Monteverde Reserve, Sendero San Luis, *Haber & Bello 2495* (MO); Monteverde Cloud Forest Reserve, road to TV towers, Pacific slope, *Haber ex Bello & Lierheimer 4466* (MO); Monteverde, upper valley and ridges of Veracruz river valley S of Monteverde Reserve, Pacific drainage, *Haber ex Bello & Lierheimer 4525* (MO); Cerro Ojo de Agua, Monteverde, *Haber & Bello 6604* (MO); Puntarenas, Monteverde, Río Guacimal valley at Lindora Electric Plant, *Haber ex Cruz 10673* (MO); Coto Brus, Zona Protectora Las Tablas, cuenca Térraba-Sierpe, *E. Navarro V. 478* (MO), *J. Quesada et al. 1764* (MO). PANAMA. **Bocas del Toro:** NE of Cerro Pate Macho, *Knapp et al. 2164* (MO). **Chiriquí:** Cerro Pata de Macho [sic], ca. 5 mi. NE of Boquete, trail to Continental Divide leading to Finca Serrano (Francisco Serrano: Pacific slope), *Antonio 2650* (MO); Renacimiento, cima de Cerro Pando y alrededores, *J. Aranda et al. 3350* (MO, PMA); Cerro Pate Macho, along the Continental Divide, on trail which leads to Finca Serrano, NE of Boquete, *Croat 48541* (MO); between Palo Alto and top of Ridge (divide) near Cerro Pate Macho, above Río Palo Alto, NE of Boquete, *D'Arcy et al. 12641* (MO); Renacimiento, Jurutungo, filo entre La Quijada del Diablo y la cima de Cerro Pando, *Galdames 3407* (MO, PMA, SCZ); E slopes of Cerro Pando, *Knapp 1640* (MO); vicinity of Cerro Punta, above Guadalupe, slopes above STRI cabin, *McPherson 9422* (MO); Cerro Pando, on the Continental Divide and the Panama–Costa Rica border, ca. 16 km NW of El Hato del Volcán, *Mori & Bolten 7321* (MO); Bugaba, Cerro Punta, *van der Werff & Herrera 6335* (BM).

II. 4. Notopleura episcandens C. M. Taylor & Lorence, sp. nov. TYPE: Panama. Panamá: amongst ridges S of Ipetí 5 hours walk from Chocó village, Serranía de Maje, 8°45′N, 77°30′W, 450–600 m, 1 Apr. 1982, *S. Knapp, R. Foster, J. Mallet & M. Huft 4506* (holotype, MO-3689783; isotype, PTBG-2647). Figure 7G, H.

Haec species a *Notopleura maxonii* limbo calycino 1.8–3 mm longo, stipularum utroque latere appendice glandulari solitario caduco triangulari 0.3–0.8 mm longo atque foliis in sicco plerumque concoloribus distinguitur.

Epiphytic, scandent, succulent suffrutescent herbs; stems to 0.5 m tall, glabrous. *Leaves* ovate to elliptic-lanceolate, 0.6–1.8 × 0.4–1 cm, at base obtuse to rounded, at apex acute to usually acuminate and apiculate, on both surfaces glabrous, when dry chartaceous, generally concolorous; secondary veins not evident; *petioles* 1.5–3 mm long; *stipules* glabrous, united around stem into a tubular continuous sheath, this 0.5–1 mm long, truncate or separating into 2 intrapetiolar segments, in middle of base of each interpetiolar side bearing 1 glandular appendage, this triangular, caducous. *Inflorescences* terminal and pseudoaxillary, cymose, glabrous; peduncle 1.5–4 mm long; branched portion pyramidal, 4–10 × 4–15 mm (not including corollas); secondary axes 1 pair; bracts triangular-subulate, 0.3–2 mm long; pedicels 0.5–3 mm long; *flowers* pedicellate in cymules of 2 to 5; hypanthium obconic, 0.5–0.8 mm long; calyx limb 1.8–3 mm long, deeply lobed, lobes 4, subequal to unequal on an individual flower, acute to acuminate; *corolla, anthers,* and *stigmas* not seen. *Fruits* ellipsoid to obovoid, 3.5–5 × 3.5–5 mm, glabrous, black; *pyrenes* 4, dorsally (abaxially) smooth.

Habitat, distribution, and phenology. In wet forests of eastern Panama at 400 to 700 m, collected in fruit in March, April, and December.

Notopleura episcandens is distinguished by its combination of relatively small leaves, reduced inflorescences, and well-developed calyx limb. It is similar to *N. maxonii*; *N. maxonii* can be distinguished from *N. episcandens* by its calyx limb 0.8–1 mm long and its leaves that are acute to cuneate at the base and generally markedly discolorous when dry. This species was first recognized by John D. Dwyer, who annotated specimens as an undescribed species of *Psychotria* with the epithet "*episcandens*" but never published this name.

Paratype. PANAMA. **Panamá:** area surrounding Rancho Chorro, mountains above Torti Arriba, Canazas mountain chain, *Folsom et al. 6672* (MO).

II. 5. Notopleura vargasiana C. M. Taylor, sp. nov. TYPE: Ecuador. Napo: Cantón Quijos, Reserva Ecológica Antisana, Cordillera de los Guacamayos, cruce del oleoducto de la compañía ARCO, entre Río Vinillos y El Mirador, 00°38′S, 77°51′W, 3–5 Jan. 1999, *H. Vargas, E. Narváez & F. Mamallacta 3294* (holotype, QCNE; isotype, MO-5568187). Figure 7C.

Haec species a *Notopleura guadalupensi* calycis limbo 1–1.3 mm longo atque corollae tubo ca. 5 mm longo ac lobulis ca. 2 mm longis distinguitur.

Succulent shrubs or suffrutescent herbs, epi-

phytic, height not noted; stems glabrous. *Leaves* elliptic to lanceolate, 1.1–4 × 0.6–1.6 cm, at apex acute, at base cuneate to obtuse, glabrous, when dry coriaceous and slightly to usually markedly discolorous; secondary and higher-order venation not visible; *petioles* 2–5 mm long; *stipules* glabrous, united around stem into a truncate tubular sheath 1.5–3 mm long, near base of interpetiolar portion with 1 to 3 linear to triangular appendices 0.5–1.5 mm long, these caducous, sheath caducous or persistent on 2 to 3 most distal nodes. *Inflorescences* terminal and pseudoaxillary, glabrous, paniculate; peduncles 1.3–2.5 cm long; branched portion 2–3.5 × 4–8 cm, corymbiform-rounded, with secondary axes 1 to 3 pairs; bracts linear to triangular, 0.5–3 mm long, acute, those subtending flowers 0.5–1.5 mm long; pedicels 0.5–1.2 mm long; *flowers* pedicellate in cymules of 2 to 3; hypanthium turbinate, ca. 1 mm long, glabrous; *calyx limb* 1–1.3 mm long, glabrous, lobed for 1/4–1/2, lobes triangular, acute; *corolla* in bud slenderly funnelform, white, externally glabrous, internally glabrous except sparsely hirtellous near middle of tube, tube to 5 mm long, lobes 4, to 2 mm long, dorsally smooth; *anthers* and *stigmas* not seen. *Fruits* obovoid, ca. 4 × 4 mm, glabrous, red; *pyrenes* 3 to 4, dorsally smooth.

Habitat, distribution, and phenology. Eastern mountains of Ecuador, in wet forest at 1350 to 2280 m; collected in flower bud in January and July, in fruit in December.

Notopleura vargasiana is similar to *N. guadalupensis* and *N. elegans* (described above). *Notopleura guadalupensis* in Panama and Colombia differs from *N. vargasiana* in its calyx limb 0.5–0.8 mm long, its corolla tubes ca. 3 mm long, its corolla lobes ca. 1 mm long, and its pyrenes 2 per fruit. *Notopleura elegans* differs from *N. vargasiana* in its calyx limbs 0.8–1.8 mm long and more deeply lobed, for 1/2 to completely, and its corolla tubes 6–10 mm long. The species epithet commemorates Homero Vargas, an Ecuadorian botanist who collected the type specimen. The fruits of *N. vargasiana* are described as red on the relatively few collections studied, but they may then quickly mature to black as in several other species of *Notopleura*.

Paratypes. ECUADOR. **Morona–Santiago:** Gualaquiza, Cordillera del Cóndor, ridgetop above Banderas, near disputed Ecuador–Peru border, *Gentry 80021* (MO); Campamento Archupalla, Cordillera del Cóndor, 15 km E of Gualaquiza, *Gentry 80321* (MO); vertiente occidental de la Cordillera del Cóndor, arriba del valle del Río Quimi, *T. Montenegro et al. 114* (MO, QCNE). **Napo:** Cordillera de Huacamayos, Km 33 Baeza–Tena road, *P. M. Jørgensen et al. 61262* (AAU); Quijos, Reserva Ecológica Antisana, Cordillera de los Guacamayos, entre El Mirador y La Virgen, oleoducto de la Compañía Arco, *H. Vargas & Narváez 3195* (MO, QCNE). **Zamora–Chinchipe:** W of Tikimints, valley or Río Coangas, *Berry & Neill 7653* (MO, QCNE); Cordillera del Cóndor, arriba del valle del Río Quimi, *Caranqui et al. 190* (MO, QCNE); Cordillera del Cóndor, cerca al destacamento militar Cóndor Mirador, en la frontera Ecuador–Perú, *E. Freire et al. 4350* (MO), *G. Pabón et al. 334* (MO); Estación Científica San Francisco, ca. Km 30 on road Loja–Zamora, *Werner 275* (MO), *Wolff 163* (MO), *Wolff 164* (MO).

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Appendix 1. List of the species of *Notopleura* by subgenus. Asterisks indicate names of species newly described in this article, except in the case of *N. madida*, which is a new combination. Daggers indicate clarifications of correct authorship noted in this article.

Subgenus Notopleura

Notopleura acuta C. M. Taylor
Notopleura aequatoriana C. M. Taylor
Notopleura aggregata (Standley) C. M. Taylor
Notopleura agostinii (Steyermark) C. M. Taylor
Notopleura albens C. M. Taylor
Notopleura amicitiae C. M. Taylor*
Notopleura aneurophylla (Standley) C. M. Taylor
Notopleura aneurophylloides (Steyermark) C. M. Taylor
Notopleura angustissima (Standley) C. M. Taylor
Notopleura anomothyrsa (K. Schumann & Donnell Smith) C. M. Taylor
Notopleura araguensis (Steyermark) C. M. Taylor
Notopleura biloba C. M. Taylor*
Notopleura bryophila C. M. Taylor*
Notopleura callejasii C. M. Taylor
Notopleura camponutans (Dwyer & M. V. Hayden) C. M. Taylor
Notopleura capacifolia (Dwyer) C. M. Taylor
Notopleura capitata C. M. Taylor*
Notopleura chapensis (Steyermark) C. M. Taylor
Notopleura cincinalis C. M. Taylor
Notopleura congesta C. M. Taylor
Notopleura corniculata C. M. Taylor*
Notopleura corymbosa C. M. Taylor*
Notopleura costaricensis C. M. Taylor*
Notopleura cundinamarcana C. M. Taylor
Notopleura decurrens (Steyermark) C. M. Taylor
Notopleura discolor (Grisebach) C. M. Taylor
Notopleura dukei (Dwyer) C. M. Taylor
Notopleura fernandezii (Steyermark) C. M. Taylor
Notopleura hondurensis C. M. Taylor
Notopleura humensis (Steyermark) C. M. Taylor
Notopleura hurtadoi C. M. Taylor*
Notopleura hypolaevis C. M. Taylor*
Notopleura iridescens C. M. Taylor
Notopleura lanosa C. M. Taylor
Notopleura lateralis (Steyermark) C. M. Taylor
Notopleura lateriflora (Standley) C. M. Taylor
Notopleura latistipula (Dwyer) C. M. Taylor
Notopleura leucantha (K. Krause) C. M. Taylor
Notopleura longiflora C. M. Taylor*
Notopleura longipedunculoides (C. M. Taylor) C. M. Taylor†
Notopleura longissima Bremekamp†
Notopleura macrophylla (Ruiz & Pavón) C. M. Taylor
Notopleura macropodantha (Standley) C. M. Taylor
Notopleura madida (Standley) C. M. Taylor*
Notopleura marginata (Bentham) Bullock
Notopleura micayensis (Standley) Bremekamp†
Notopleura microbracteata (Steyermark) C. M. Taylor
Notopleura montana C. M. Taylor*
Notopleura multinervia C. M. Taylor*
Notopleura nepokroeffiae (Standley ex Steyermark) C. M. Taylor
Notopleura obtusa C. M. Taylor*
Notopleura pacorana C. M. Taylor*
Notopleura palestinae (Standley ex Steyermark) C. M. Taylor
Notopleura panamensis (Dwyer) C. M. Taylor
Notopleura parasiggersiana C. M. Taylor
Notopleura parvifolia C. M. Taylor*
Notopleura patria (Standley & Steyermark) C. M. Taylor
Notopleura penduliflora C. M. Taylor*
Notopleura perparva (Dwyer) C. M. Taylor
Notopleura pilosula C. M. Taylor
Notopleura plagiantha (Standley) C. M. Taylor
Notopleura polyphlebia (Donnell Smith) C. M. Taylor
Notopleura pyramidata C. M. Taylor
Notopleura sanblasensis C. M. Taylor*
Notopleura saulensis (Steyermark) C. M. Taylor
Notopleura scarlatina C. M. Taylor
Notopleura siggersiana (Standley) C. M. Taylor
Notopleura spiciformis C. M. Taylor*
Notopleura standleyana (Steyermark) C. M. Taylor
Notopleura steyermarkiana C. M. Taylor
Notopleura subimbricata (Steyermark) C. M. Taylor
Notopleura submarginalis C. M. Taylor
Notopleura sucrensis (Steyermark) C. M. Taylor
Notopleura tapajozensis (Standley) Bremekamp
Notopleura terepaimensis (Steyermark) C. M. Taylor
Notopleura thesceloantha (Steyermark) C. M. Taylor
Notopleura tolimensis (Wernham) C. M. Taylor
Notopleura tonduzii (Standley) C. M. Taylor
Notopleura torrana C. M. Taylor*
Notopleura triaxillaris C. M. Taylor
Notopleura tubulistipula C. M. Taylor*
Notopleura uberta (Standley & Steyermark) C. M. Taylor
Notopleura uliginosa (Swartz) Bremekamp
Notopleura wilburiana (Dwyer) C. M. Taylor
Notopleura zarucchiana C. M. Taylor*

Subgenus Viscagoga

Notopleura aligera (Steyermark) C. M. Taylor
Notopleura bahiensis C. M. Taylor*
Notopleura cocleensis C. M. Taylor*
Notopleura crassa (Bentham) C. M. Taylor
Notopleura elegans C. M. Taylor*
Notopleura epiphytica (K. Krause) C. M. Taylor
Notopleura episcandens C. M. Taylor*
Notopleura guadalupensis (DC.) C. M. Taylor
Notopleura maxonii (Standley) C. M. Taylor
Notopleura merumensis (Steyermark) C. M. Taylor
Notopleura multiramosa (Steyermark) C. M. Taylor
Notopleura peperomiae (Standley) C. M. Taylor
Notopleura perpapillifera (Steyermark) C. M. Taylor
Notopleura pithecobia (Standley) C. M. Taylor
Notopleura vargasiana C. M. Taylor*

Quercus nixoniana (Fagaceae), una Nueva Especie de la Sección *Lobatae*, de la Sierra Madre del Sur, México

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RESUMEN. Se describe e ilustra *Quercus nixoniana*, una especie nueva de los estados de Jalisco, Guerrero y Oaxaca, en la Sierra Madre del Sur. Esta especie se incluye en la sección *Lobatae* Loudon (encinos rojos) por presentar el ápice de la lámina de la hoja aristado, endocarpo tomentoso y flores pistiladas con perianto libre formando un reborde. Se discute su parecido morfológico con *Q. salicifolia* Née y *Q. crispifolia* Trelease, con las que comparte la forma lanceolada de la hoja, el indumento en la misma y los frutos canescentes. También se presenta una clave para separar a los tres taxa.

ABSTRACT. *Quercus nixoniana* is described as a new species from the states of Jalisco, Guerrero, and Oaxaca at Sierra Madre del Sur, Mexico. It is included in *Quercus* sect. *Lobatae* Loudon (red oaks) because of the leaves with a terminal seta, the tomentose endocarp, and the base of the pistillate perianth free, forming a skirt or flange. It resembles *Q. salicifolia* Née and *Q. crispifolia* Trelease in the lanceolate blade, indument, and canescent acorns. A key for distinguishing the three taxa is included.

Key words: Fagaceae, *Quercus*, section *Lobatae*, Mexico, Sierra Madre del Sur.

La revisión detallada de un grupo de especies del género *Quercus* L., de la sección *Lobatae* Loudon (encinos rojos) en México, permitió el hallazgo de una especie no descrita en la literatura y cuya distribución se restringe a la Sierra Madre del Sur, particularmente en los estados de Jalisco, Guerrero y Oaxaca. Los ejemplares de esta especie colectados en el estado de Guerrero junto con otros, pertenecientes a *Quercus crispifolia* Trelease, fueron incluidos originalmente en *Q. salicifolia* Née (Valencia, 1995) por presentar hojas lanceoladas, frutos de maduración anual y distribución en la misma región fisiográfica; sin embargo, colectas posteriores permitieron diferenciar al taxon aquí descrito porque tiene hojas totalmente glabras y amentos pistilados de 8.0–35.0 mm de largo con 2 a 5 (o hasta 9) flores hacia el extremo distal del pedúnculo, por lo cual se propone como una especie nueva.

Quercus nixoniana Valencia & Lozada, sp. nov.
TIPO: México. Guerrero: Mun. Atoyac de Alvarez, aprox. 0.5 km al W de El Molote, 17°25′28.2″N, 100°10′21″W, bosque mesófilo de montaña, 1675 m, 24 abr. 1998, *R. de Santiago 747* (holótipo, FCME; isótipos, BH, IBUG, MEXU, MO, XAL). Figura 1.

Arbores ad 25 m altae. Ramuli 1.0–1.8 mm crassi, glabri vel cum trichomatibus stellatis et vix puberulis. Lamina coriaceo-papiracea, anguste elliptica vel anguste lanceolata, 7.0–16 cm longa, 1.1–2.1(–2.8) cm lata, 5 ad 8plo longius quam lata; apex acutus; nervius secundarius 15 ad 22; margo integer; subtus glabra, vix papilosa; basis cuneata. Amenta pistillata axillaria, 8.0–35.0 mm longa, 2 ad 5(ad 9) floribus ad extremum pedunculi. Fructus annuus, binis vel ternis aggregatis; cupula ovoidea, canescens, 9.0–17.0 mm longa, 8.2–14.0 mm lata.

Haec species inter congeneros ad sectionem *Lobatas* pertinentes ad *Q. salicifoliam* et *Q. crispifoliam* maxime accedit, sed ab eis lamina foliari angustiore abaxialiter omnino glabra atque floribus foemineis in inflorescentias multifloras dispositis distinguitur.

Árboles de 20.0–25.0 m de alto y fuste de 40.0 cm de diámetro. Ramillas de 1.0–1.8 mm de diámetro, surcadas, lenticelas inconspicuas; pubescentes, glabras o conservando algunos diminutos pelos estrellados y levemente puberulentas. Yemas ovoides a cónicas, de 2.6–3.8 × 1.2–1.7 mm, escamas color ambar, anchamente ovoides, glabras, con margen cortamente fimbriado. Estípulas ausentes cuando las hojas están completamente maduras. Hojas con pecíolos de (3.7–)4.2–7.0 × 0.9–1.2 mm; láminas coriáceo-papiráceas, estrechamente elípticas a lanceoladas, de 7.0–16.0 × 1.1–2.1

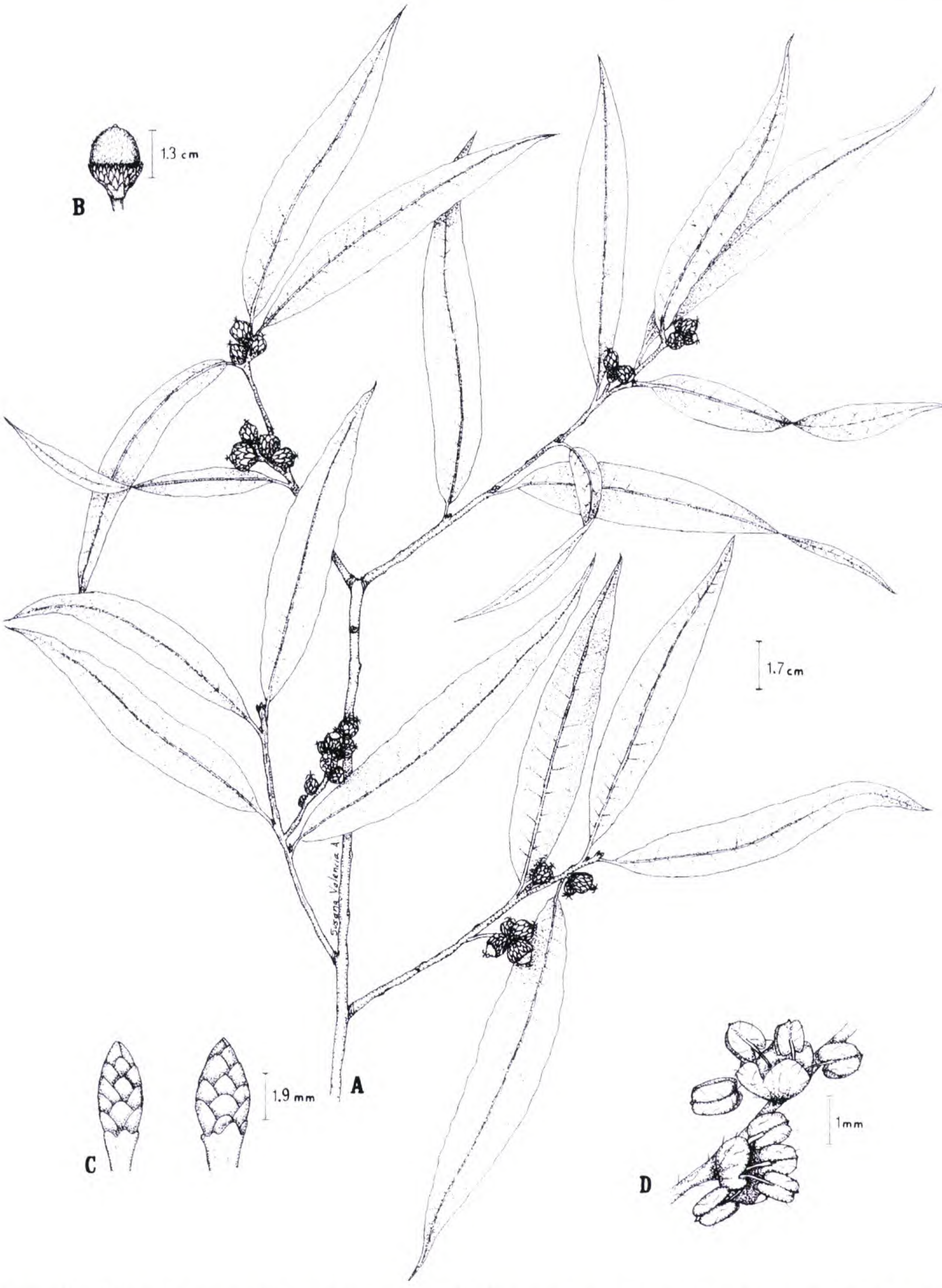

Figura 1. *Quercus nixoniana* Valencia & Lozada. —A. Rama con hojas y frutos inmaduros. —B. Fruto maduro. —C. Yemas. —D. Flores masculinas. (Dibujado de *R. de Santiago 747*: A, C del holótipo; B, D de un isótipo.)

(–2.8) cm, de 5–8 veces mas largas que anchas; ápice agudo a acuminado; base cuneada, margen entero, crispado; venas secundarias en número de 15 a 22 a cada lado de la vena media, ligeramente ascendentes y casi rectas, ramificándose y anastomosándose poco antes de llegar al margen; haz opaco y algo glauco, venas y venillas lisas a ligeramente elevadas, amarillentas; envés glabro, epidermis papilosa; venillas ligeramente notorias, más pálidas que la superficie superior. Amentos estaminados ca. 3.0 cm de largo; raquis de 0.3–0.5 mm de grueso, ligeramente piloso; flores densamente distribuidas a lo largo del raquis, sésiles o casi sésiles, perianto cupuliforme, unido casi un medio de su longitud, dejando libres cuatro lóbulos obtusos ca. 0.5 mm de largo, ligeramente pilosos, estambres 4 a 5 por flor, de 2.0–2.5 mm de largo, anteras exsertas de 1.0–1.2 mm de largo, mucronadas y ligeramente pilosas. Amentos pistilados axilares de 8.0–35.0 mm de largo, con 2 a 5(a 9) flores hacia el extremo del pedúnculo. Frutos anuales, en grupos de 2 a 3 sobre un pedúnculo de 6.4–20 × 1.5 mm; copas con forma turbinada, margen erecto, de 10.0–11.5 mm de diámetro y 6.0–7.7 mm de alto y de 2.9–3.1 mm de profundidad; escamas lisas, con tomento plateado; bellotas ovoides, canescentes, de 9.0–17.0 × 8.2–14.0 mm, incluido en la copa 1/3 de su longitud.

De acuerdo con la clasificación propuesta por Nixon (1993), *Quercus nixoniana* se incluye en la sección *Lobatae* por presentar hojas con ápice aristado, flores pistiladas con perianto libre formando un reborde y endocarpo tomentoso.

Quercus nixoniana es similar morfológicamente a *Q. salicifolia* y *Q. crispifolia* por presentar hojas lanceoladas, glabras o glabradas y bellotas canescentes de maduración anual. La revisión de fotografías del tipo de *Q. salicifolia* (*Née 25957*, holótipo: MA), de la descripción original (Née, 1801) y de colectas provenientes de la localidad tipo (cerca de Acapulco, Guerrero), permiten diferenciarla porque *Q. nixoniana* tiene hojas con el margen entero, venas secundarias en número de 15 a 22 a cada lado de la vena media, el envés es totalmente glabro y las inflorescencias femeninas con 2 a 5 (hasta 9) flores; mientras que *Q. salicifolia* tiene hojas ocasionalmente lobuladas y con margen que puede llevar de uno a dos dientes aristados hacia el ápice, venas secundarias de 12 a 16 a cada lado de la vena media, con algunos mechones de pelos estipitados en las axilas de las venas secundarias e inflorescencias femeninas bifloras. Según la descripción original (Trelease, 1924) y las fotografías del tipo de *Q. crispifolia* (*Reves 4;* holótipo: ILL, publicadas en Trelease, 1924, pl. 286 a y b) ésta especie difiere de *Quercus nixoniana* por tener hojas más anchas (de 3–4 veces mas largas que anchas), con venas secundarias en número de 13 a 17 a cada lado de la vena media, por conservar algunos mechones de pelos estipitados en las axilas de las venas secundarias y el fruto puede alcanzar hasta 20 × 30 mm. No obstante que las tres especies se distribuyen en la Sierra Madre del Sur, los pisos altitudinales que ocupan son diferentes, así *Q. salicifolia* generalmente se encuentra por debajo de los 750 m de altitud, *Q. crispifolia* entre 750 y 1500 m y *Q. nixoniana* entre los 1300 y 2300 m.

Quercus nixoniana tiene como hábitat los bosques de Pino-encino, mesófilo de montaña y de *Quercus*, en asociación con individuos de los géneros *Carpinus, Meliosma, Sloanea, Symplocos, Styrax* y *Tilia*, entre 1300 y 2300 m de altitud. Florece de enero a febrero y fructifica de junio a julio.

El epíteto específico honra a Kevin C. Nixon quien ha trabajado durante muchos años con el género *Quercus*.

Clave para la Determinación de *Quercus crispifolia*, *Q. nixoniana* y *Q. salicifolia*

1a. Envés de las hojas totalmente glabras; 5.0–8.0 veces más largas que anchas; flores femeninas en inflorescencias bifloras o multifloras . . . . . *Q. nixoniana*

1b. Envés de las hojas conservando mechones de pelos estipitados en las axilas de las venas secundarias; 3.0–4.5 veces más largas que anchas; flores femeninas en inflorescencias bifloras.

2a. Hojas obovadas a oblanceoladas, margen entero y crispado; frutos de 20.0 × 30.0 mm . . . . . *Q. crispifolia*

2b. Hojas lanceoladas, elípticas o rara vez oblanceoladas, margen ligeramente ondulado; frutos de 9.0 × 15.0 mm . . . . . *Q. salicifolia*

Parátipos. MÉXICO. **Guerrero:** Municipio Atoyac de Álvarez, Atoyac, *Palacios 1* (MEXU); El Molote, huerta de Don Margarito Valladares, *E. León 177* (FCME); El Molote, 1 km del poblado, *J. Rojas 121* (FCME); Municipio Coyuca de Catalán, Las Palancas, *X. Madrigal S. 2482* (MEXU); Municipio Heliodoro Castillo, Agua Fría, 2.83 km al S, *R. Cruz Durán 4390* (FCME); Cerro Teotepec near Puerto El Gallo, *D. E. Breedlove 61942, 61959* (MEXU). **Jalisco:** Municipio Autlán, sobre el camino al Puerto de San Campus, Las Joyas, Autlán, *A. Vázquez 3379* (MEXU); Municipio Cuautitlán, along road from El Chante to El Guisar, *Breedlove 61803, 61798, 61795* (MEXU); Municipio Talpa de Allende, 15 km al S de Talpa, sobre el camino a La Cuesta, *Rzedowski 15208* (MEXU). **Oaxaca:** Sin Municipio, Trinidad Buenavista, *Luna A. de L. s.n.* (FCME).

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Nomenclatural Notes on *Sisymbrium* (Brassicaceae)

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ABSTRACT. Recent molecular studies, combined with critical evaluation of morphology, support a revision of the generic placement of five species of *Sisymbrium* (Brassicaceae). *Sisymbrium aculeolatum* and *S. afghanicum* (formerly in *Neotorularia*) and *S. linifolium* (formerly in *Schoenocrambe*) should be maintained in *Sisymbrium*. A new name, *Erucastrum austroafricanum*, is proposed to accommodate the transfer of *S. thellungii* to *Erucastrum* and to avoid the creation of a latter homonym. A new combination, *E. supinum*, is proposed to transfer *S. supinum* to *Erucastrum*.

Key words: Brassicaceae, *Erucastrum, Neotorularia, Schoenocrambe, Sisymbrium.*

Sisymbrium L. is a large and heterogeneous genus of about 96 species (Warwick et al., 2002). It was divided by Schulz (1924, 1936) into 14 sections, but as indicated by Al-Shehbaz (1988) and Warwick et al. (2002) these sections are artificially delimited, and the genus is polyphyletic. Based on recent analysis of ITS DNA sequence data (Warwick et al., 2002), *Sisymbrium* species split into two major groups: Old World *Sisymbrium* (including *Sisymbrium aculeolatum* Boissier, *S. afghanicum* Gilli, and *S. linifolium* (Nuttall) Nuttall ex Torrey & A. Gray) and New World *Sisymbrium* (along with most genera of the tribe Thelypodieae). Two Old World species, *S. supinum* L. and *S. thellungii* O. E. Schulz, fell within the tribe Brassiceae. The ITS sequence data, combined with critical evaluation of morphology, support revision of the generic placement of these five species of *Sisymbrium*.

Sisymbrium aculeolatum Boissier and *S. afghanicum* Gilli

Sisymbrium aculeolatum (Afghanistan, Iran, Pakistan, Sinai) and *S. afghanicum* (Afghanistan and Pakistan) were originally described by Boissier (1842) and Gilli (1955), respectively. They were transferred to *Torularia* (Cosson) O. E. Schulz by Schulz (1924) and Hedge (1968), respectively, and eventually to *Neotorularia* Hedge & Léonard (Léonard, 1986). The two species are morphologically similar to *Sisymbrium* in flower, fruit, and trichome morphology, but they differ from all other species of *Neotorularia* by having non-torulose fruits and an indumentum consisting exclusively of simple trichomes. By contrast, all other species of *Neotorularia* have distinctly torulose fruits and branched trichomes (Appel & Al-Shehbaz, 2002). These differences are substantial and consistent with the exclusion of these two species from *Neotorularia* and their placement within *Sisymbrium*.

Sisymbrium linifolium (Nuttall) Nuttall ex Torrey & A. Gray

This species, which is restricted to the western United States and adjacent Canada, was originally described as *Nasturtium linifolium* Nuttall (Nuttall, 1834) and moved to *Sisymbrium linifolium* (Torrey & Gray, 1838). It was later placed in *Schoenocrambe* Greene (Greene, 1896) as the generic type and maintained in that genus (Rollins, 1982, 1993). Several authors (Payson, 1922; Schulz, 1924; Al-Shehbaz, 1973) indicated that *Schoenocrambe linifolia* (Nuttall) Greene is morphologically very similar in habit, leaves, and flowers to the Eurasian *Sisymbrium polymorphum* (Murray) Roth and retained it in *Sisymbrium*. Both species are perennials with finely divided lower leaves, entire upper leaves, two-lobed stigmas, and yellow flowers. Results from ITS sequence data (Warwick et al., 2002) support the placement of this species in *Sisymbrium* as a sister taxon to *S. polymorphum* within the Old World *Sisymbrium* clade. Morphological and molecular sequence data, therefore, support the maintenance of this species in *Sisymbrium*. As for the other species recognized by Rollins (1982, 1993) in *Schoenocrambe*, they should be retained in *Thelypodiopsis* Rydberg until further studies prove otherwise.

Sisymbrium thellungii O. E. Schulz

This South African species was originally described as *Brassica pachypoda* Thellung (Thellung & Schintz, 1912). It was excluded from *Brassica* L. by Schulz (1919) and was renamed as *Sisymbrium thellungii* because the transfer of *B. pachypoda* to *Sisymbrium* would have created a latter homonym of *S. pachypodum* Chiovenda. Schulz (1924) created the superfluous new combination *S. pachypodum* (Thellung) O. E. Schulz & Thellung. Morphologically, it is an anomaly in *Sisymbrium* because it has conduplicate cotyledons (Schulz, 1924; Marais, 1970; Al-Shehbaz, pers. obs.), a feature restricted to the tribe Brassiceae (Al-Shehbaz, 1985; Gómez-Campo, 1980, 1999; Anderson & Warwick, 1999). Results of the ITS sequence data (Warwick et al., 2002; Warwick & Sauder, unpublished data) showed that *S. thellungii* fell within the tribe Brassiceae in a clade that included the African *Erucastrum abyssinicum* (A. Richard) R. E. Fries, *E. griquense* (N. E. Brown) O. E. Schulz, and *E. strigosum* (Thunberg) O. E. Schulz. Morphological and molecular data, therefore, support the assignment of *S. thellungii* to the genus *Erucastrum*. However, the older specific epithet, *pachypoda*, cannot be used in *Erucastrum* C. Presl because of the existence of the earlier homonym *E. pachypodum* (Chiovenda) Jonsell (Jonsell, 1976). Similarly, the epithet *thellungii* cannot be used in *Erucastrum* because of the existence of *E. thellungii* O. E. Schulz (Schulz, 1916). The following new name in *Erucastrum* is proposed.

Erucastrum austroafricanum Al-Shehbaz & Warwick, nom. nov. Replaced name: *Brassica pachypoda* Thellung, in Thellung & Schinz, Vierteljahrsschr. Nat. Ges. Zürich 56: 257. 1911 (1912), non *Erucastrum pachypodum* (Chiovenda) Jonsell, Bot. Not. 129: 127. 1976. *Sisymbrium thellungii* O. E. Schulz, Pflanzenr. IV. 105 (Heft 70): 83. 1919, non *Erucastrum thellungii* O. E. Schulz, Bot. Jahrb. 54, Beibl. 119: 54. 1916. TYPE: South Africa. Transvaal, Pretoria, 1904, *R. Leendertz 416* (lectotype, designated here, Z).

In his original description of *Brassica pachypoda*, Thellung (in Thellung & Schinz, 1912) cited three syntypes, of which the most complete specimen is designated herein as the lectotype. Both *B. pachypoda* and *Sisymbrium thellungii* were based on the same type collections.

Sisymbrium supinum L.

This European species was described by Linnaeus (1753) and has been maintained in *Sisymbrium* in numerous accounts (e.g., Schulz, 1924; Ball, 1993; Jalas & Suominen, 1994). An examination of the seeds of *S. supinum* showed that the cotyledons are slightly conduplicate. As indicated above, conduplicate cotyledons are restricted to the tribe Brassiceae. A re-evaluation of the overall morphology revealed that *S. supinum* is very similar to *Erucastrum gallicum* (Willdenow) O. E. Schulz, a member of the tribe Brassiceae. Both have fully bracteate inflorescences, pinnately divided leaves, and slightly beaked fruits. Results from the phylogenetic analysis of ITS DNA sequence data (Warwick et al., 2002; Warwick & Sauder, unpublished data) showed that *S. supinum* fell within the tribe Brassiceae in a clade with *Diplotaxis erucoides* (L.) DC. and *D. cossoniana* (Reuter ex Boissier) O. E. Schulz. This is similar to *E. gallicum*, where chloroplast DNA studies showed that *E. gallicum* formed a clade with *D. erucoides/D. cossoniana* (Warwick & Black, 1993). *Erucastrum gallicum* ($n = 15$) is an allopolyploid derived from *D. erucoides/D. cossoniana* ($n = 7$) as the female parent and *E. nasturtiifolium* (Poiret) O. E. Schulz ($n = 8$) as the male parent (Warwick & Black, 1993; Warwick & Anderson, 1997; Warwick & Wall, 1998). Unfortunately, reliable chromosome counts for *S. supinum* do not exist (Jalas & Suominen, 1994). Morphological data support the assignment of *S. supinum* to *Erucastrum* rather than *Diplotaxis* DC. as the latter characteristically has biseriate seeds and ebracteate inflorescences. The following new combination in *Erucastrum* is proposed.

Erucastrum supinum (L.) Al-Shehbaz & Warwick, comb. nov. Basionym: *Sisymbrium supinum* L., Sp. Pl. 2: 657. 1753. TYPE: Herb. Linn. 836.12 (lectotype, designated by Jarvis & Jonsell (2002: 72), LINN).

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A New Subspecies of *Arceuthobium tsugense* (Viscaceae) from British Columbia and Washington

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ABSTRACT. The dwarf mistletoe parasitizing shore pine in British Columbia, Canada, and Washington, U.S.A., is described as a subspecies of hemlock dwarf mistletoe, *Arceuthobium tsugense*, based on morphology and differences in host susceptibility of western hemlock and shore pine to the shore pine dwarf mistletoe, *Arceuthobium tsugense* subsp. *contortae*.

Key words: British Columbia, hemlock dwarf mistletoe, Orcas Island, shore pine, Vancouver Island, western hemlock.

The taxonomic status of the dwarf mistletoe parasitizing shore pine (*Pinus contorta* Douglas ex Louden var. *contorta*) in British Columbia, Canada, and Washington, U.S.A., has long been debated (Gill, 1935; Hunt & Smith, 1978; Hawksworth, 1987; Hawksworth & Wiens, 1972, 1996; Nickrent & Stell, 1990; Nickrent et al., 1994). This mistletoe was first classified by Gill (1935) as *Arceuthobium campylopodum* Engelmann forma *typicum*. Gill based his classification of *A. campylopodum* on his host form concept, and this dwarf mistletoe was placed in the form that included parasites of *Pinus* spp. (f. *typicum*). In their monograph of *Arceuthobium*, Hawksworth and Wiens (1972) classified the dwarf mistletoe parasitizing shore pine as hemlock dwarf mistletoe (*Arceuthobium tsugense* (Rosendahl) G. N. Jones), whose principal host is western hemlock (*Tsuga heterophylla* (Rafinesque) Sargent). However, Hawskworth and Wiens noted that, based on observations reported by Kuijt (1956), shore pines were often severely infected by hemlock dwarf mistletoe in forests where there was little or no infection on western hemlock.

Investigations of the host range of hemlock dwarf mistletoe on Vancouver Island (Smith & Wass, 1976; Wass, 1976) confirmed that western hemlock was much less severely infected by the dwarf mistletoe parasitizing shore pine. Further evidence of the differences in susceptibility of shore pine and western hemlock to these dwarf mistletoes was demonstrated by a series of artificial inoculation studies. Smith and Wass (1979) demonstrated that the dwarf mistletoe from shore pine produced only a few infections on western hemlock (7% of the inoculations), and only a few shoots were produced on these infections. In addition, these tests found that the dwarf mistletoe from western hemlock caused few infections on shore pine (1%), but the infections produced more shoots. Smith (1974) also demonstrated that dwarf mistletoe from shore pine produced low levels of infection on western hemlock (1%) and no shoots, while dwarf mistletoe from western hemlock produced higher levels of infection (22%) and 100% shoot production on western hemlock. Other inoculation experiments using seeds of the dwarf mistletoe from shore pine also resulted in few infections on western hemlock (3%), but all of the infections produced aerial shoots (Wass, unpublished). Inoculations on shore pine produced many more viable infections (42%) and all of the infections produced shoots. In these experiments, inoculations with seeds from the dwarf mistletoe on western hemlock onto shore pine produced no infections, while 29% of seeds inoculated on western hemlock produced infections and 93% of these produced aerial shoots (Wass, unpublished).

Hawksworth (1987) summarized the taxonomy of hemlock dwarf mistletoe and separated this species into three different races: a western hemlock race, a shore pine race, and a mountain hemlock race. Hawksworth et al. (1992) presented another interpretation for the classification of hemlock dwarf mistletoe. They described the mountain hemlock race proposed by Hawksworth (1987) as a subspecies of hemlock dwarf mistletoe (mountain hemlock dwarf mistletoe—*Arceuthobium tsugense* (Rosendahl) G. N. Jones subsp. *mertensianae* Hawksworth & Nickrent), but maintained the dwarf mistletoe

parasitizing shore pine as a race of hemlock dwarf mistletoe. Nickrent and Stell (1990) reported that their analysis of isozymes could not be used to distinguish the dwarf mistletoe parasitizing shore pine from the mistletoe parasitizing western hemlock and Nickrent et al. (1994) reported that nuclear ribosomal DNA internal transcribed spacer sequences were not useful in distinguishing between the subspecies or races of hemlock dwarf mistletoe. Therefore, in a revision of their monograph on *Arceuthobium*, Hawksworth and Wiens (1996) maintained the race designation for the dwarf mistletoe on shore pine.

In 1997, we began intensive studies of the morphology and host range of hemlock dwarf mistletoe throughout its geographic range. Based on the results of our work, we provide data that support the classification of the dwarf mistletoe parasitizing shore pine in British Columbia and Washington as a subspecies of hemlock dwarf mistletoe, thereby eliminating the use of the race concept in *Arceuthobium*.

Arceuthobium tsugense (Rosendahl) G. N. Jones subsp. **contortae** Wass & Mathiasen, subsp. nov. TYPE: Canada. British Columbia: Vancouver Island, Mount Wells, elevation ca. 335 m, 8 Aug. 2001, *E. F. Wass 26096* (holotype, DAVFP; isotypes, ASC, MO, US).

Plantae 3–11 (6) cm altae; anthesis mense Julio–Octobri; fructus maturitas Augusto–Novembri. In *Pinus contorta* var. *contorta* parasiticae.

Plants 3–11 cm in height (mean ca. 6 cm); basal diameter of dominant plants 2–5 mm (mean 3 mm); third internode length 5–16 mm (mean 9.95 mm) and 1.75 mm wide; staminate and pistillate plants primarily green-brown, but some yellow-green; staminate flowers 3- or 4-partite; mature fruit length 3.3–5.7 mm (mean 4.6 mm) and 2.1–4.2 mm wide (mean 3.1 mm). Seed length 1.8–3.0 mm (mean 2.5 mm) and width 1.0–1.7 mm (mean 1.4 mm).

Phenology. Anthesis from mid July through early October with peaks in late July to mid August; seed dispersal from mid September to early November with peaks in mid September to mid October.

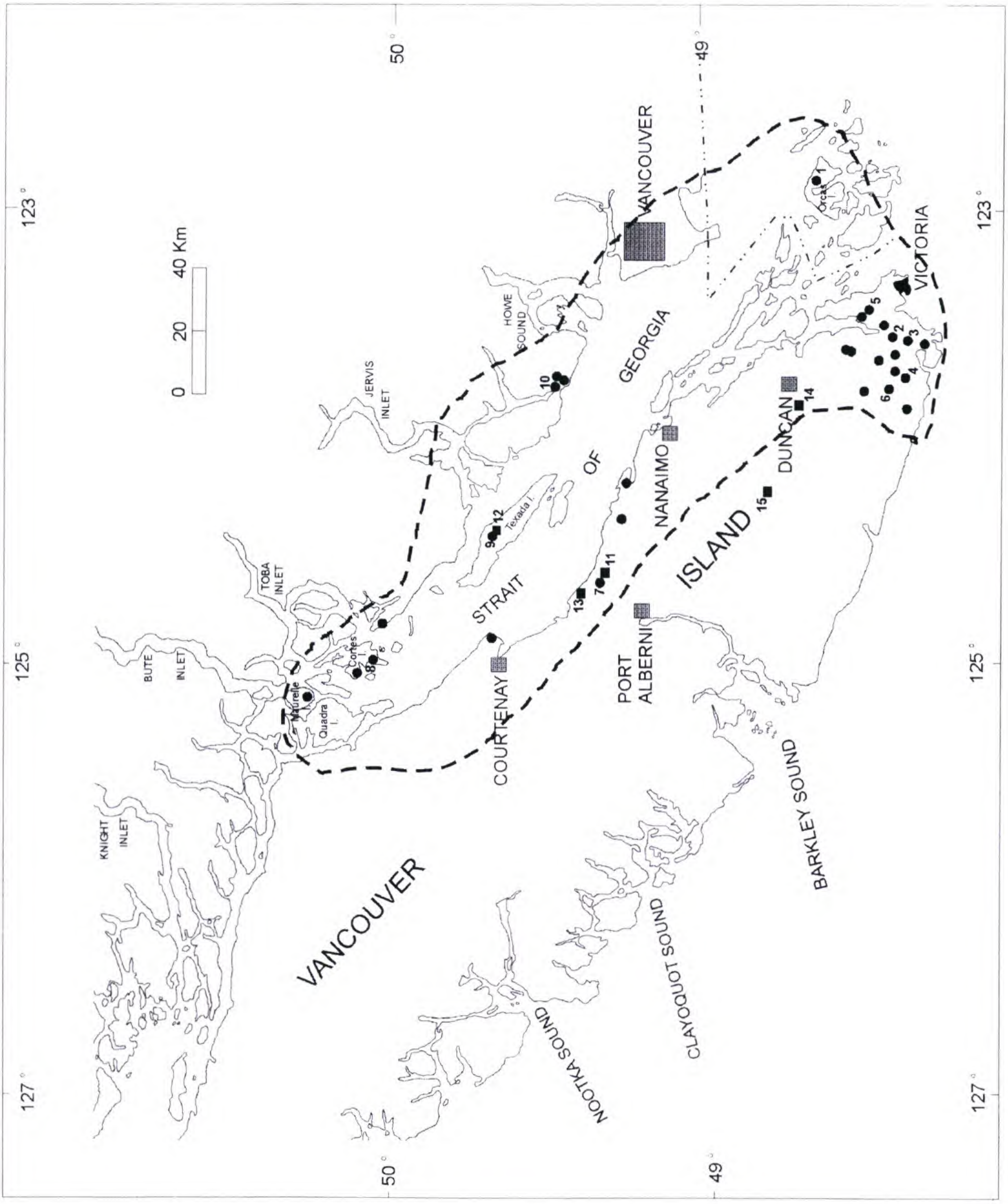
Habit. Parasitic principally on *Pinus contorta* var. *contorta*, but occasionally parasitic on *Tsuga heterophylla* and rarely on *Pinus monticola* Douglas ex D. Don.

Distribution. Shore pine dwarf mistletoe (SPDM) occurs on Vancouver Island and other islands off the coast of British Columbia as far north as Maurelle Island and on the mainland coast of British Columbia from south of Sechelt to near Powell River (Fig. 1). There are also reports of SPDM near Port Clements on the Queen Charlotte Islands, on Malcolm Island, and near Terrace, British Columbia (Smith & Wass, 1976; Wass, 1976; Hawksworth, 1987). These represent possible populations of SPDM that are approximately 400–500 km north of the northernmost populations on Vancouver Island or the main coast of British Columbia. Examination of the dwarf mistletoe collection records for the Port Clements and Malcolm Island sites and a visit to the Terrace site indicated that these sites are actually rare crossovers of western hemlock dwarf mistletoe onto shore pine. Therefore, the northern range limit of shore pine dwarf mistletoe is on Maurelle Island (Fig. 1). Elevational range is from near sea level to 800 m.

Morphological Measurements

Ten SPDM populations scattered throughout its principal range in British Columbia and on Orcas Island were sampled (Fig. 1). Five western hemlock dwarf mistletoe (WHDM) populations from within the geographic range of SPDM and 14 other WHDM populations were sampled for comparison (Figs. 1, 2). From each population, 20 infections (10 male and 10 female) were collected and the dominant shoot from each infection was used for morphological measurements. The infections were collected, placed in a cooler to keep them fresh during transport, and stored in a cold room until measured. Plant measurements were made within two days of collection. The dwarf mistletoe plants were measured using a dissecting microscope with a micrometer.

The dwarf mistletoe plant characters measured were those used by Hawksworth and Wiens (1996) for taxonomic classification. The following morphological characters were recorded: (1) height, basal diameter, third internode length and width, and color of the tallest male and female shoot from each infection collected; (2) mature fruit length, width, and color; (3) seed length, width, and color; (4) staminate flower diameter; (5) number, length, and width of staminate perianth lobes; (6) anther distance from the perianth lobe tip; (7) anther diameter; and (8) pre-flowering lateral staminate spike length. Analysis of variance (ANOVA), using a general linear model procedure for unbalanced designs, was used to determine significant differences between shore pine dwarf mistletoe and western hemlock dwarf mistletoe morphological measurements ($F \leq 0.05$). All statistical analyses were performed with SAS computer programs (SAS Institute Inc., 1985).


50°
49°
123°
125°
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0 20 40 Km
VANCOUVER
GEORGIA
STRAIT
OF
JERVIS INLET
HOWE SOUND
TOBA INLET
BUTE INLET
KNIGHT INLET
Texada I.
Cortes I.
Maurelle I.
Quadra I.
Orcas I.
NANAIMO
DUNCAN
COURTENAY
PORT ALBERNI
VICTORIA
ISLAND
CLAYOQUOT SOUND
BARKLEY SOUND
NOOTKA SOUND
1
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Male plants of shore pine dwarf mistletoe were significantly shorter (mean 5.6 cm) than those of western hemlock dwarf mistletoe (mean 7.8 cm). Although the range in male plant height of the two mistletoes overlaps somewhat, the tallest plants of SPDM do not reach the maximum heights of WHDM (Table 1). Shoot third internode length was significantly shorter and third internode width was significantly wider for SPDM than for WHDM (Table 1). Staminate flower diameter, perianth length, and perianth width were significantly larger for SPDM than for WHDM. Anther distance from perianth tip was significantly greater for SPDM than for WHDM (Table 1). Another difference between SPDM and WHDM is plant color. Male plants of SPDM are predominantly green-brown whereas male plants of WHDM are predominantly green-yellow. For both mistletoes, the number of perianth lobes on male flowers is three or four, but the predominance of 3-partite or 4-partite flowers varies.

Female plants of shore pine dwarf mistletoe were significantly shorter (mean 6.6 cm) than those of western hemlock dwarf mistletoe (mean 8.0 cm) (Table 2). Again, the range in heights of the dominant female plants overlaps for these mistletoes, but the height of SPDM female plants does not reach the size of those of WHDM (Table 2). Shoot third internode length was significantly shorter for SPDM than for WHDM. The fruit width and seed width of SPDM were significantly wider than for WHDM. The color of female plants of SPDM is predominantly green-brown. Female plants of WHDM are green-brown, green-yellow, or purplish. Fruit and seed color is similar for both mistletoes, as is seed length (Table 2). Table 3 summarizes the principal morphological differences between SPDM and WHDM.

Host Susceptibility Based on Natural Infection

In order to determine the susceptibility of shore pine and western hemlock to shore pine dwarf mistletoe and western hemlock dwarf mistletoe based on natural infection, 173 temporary plots 6 meters in radius (0.04 ha) were established around large, severely infected residual trees (western hemlock or shore pine) at 10 locations (Fig. 1). In each plot, trees greater than 1.37 meters in height were sampled and the species and dwarf mistletoe rating (DMR, Hawksworth, 1977) was recorded for each live tree in a plot.

Ninety-nine percent of the shore pine sampled (765 trees) in the plots located in shore pine forests were infected by shore pine dwarf mistletoe (Table 4), and these trees had a mean DMR of 5.0 on a scale of 0–6. This high level of infection clearly demonstrates the high level of susceptibility of shore pine to this mistletoe.

In forests composed of mixtures of shore pine and western hemlock infested with shore pine dwarf mistletoe, 95% of the shore pine was infected, and these trees had a mean DMR of 3.7. Of the 802 western hemlocks sampled in these forests, only 21% were infected by shore pine dwarf mistletoe (Table 4). These western hemlocks only had a mean DMR of 0.3. These infection levels indicate that shore pine is highly susceptible to infection by SPDM while western hemlock is clearly much less susceptible.

In forests of mixed shore pine and western hemlock infested with western hemlock dwarf mistletoe, 96% of the 138 western hemlock sampled were infected (Table 4). These trees were severely infected because their average DMR was 4.3. In contrast, WHDM infection of the shore pine sampled (77 trees) was only 1% with an average DMR of only 0.1. These infection incidences demonstrate the high susceptibility of western hemlock to WHDM (a principal host) and the very low susceptibility of shore pine (a rare host) (Table 4).

Shore Pine Dwarf Mistletoe

Plants of shore pine dwarf mistletoe and western hemlock dwarf mistletoe have morphological similarities, but they also have some consistent morphological differences (Table 3). Male and female plants of SPDM are consistently smaller than WHDM. In addition, the color of male SPDM plants is frequently green-brown and occasionally yellow-green, while the color of WHDM male plants is consistently yellow-green. Staminate flowers of SPDM are consistently larger than the flowers of

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Figure 1. Dashed line encloses the distribution of *Arceuthobium tsugense* subsp. *contortae*. Black circles indicate known populations and numbered circles indicate populations sampled for morphological measurements and host susceptibility: Washington: 1—Orcas Island; British Columbia: 2—Mount Wells, 3—Mount Helmcken, 4—Bluff Mountain, 5—Mount Work, 6—Trap Mountain, 7—Spider Lake, 8—Cortes Island, 9—Texada Island, 10—Sechelt. Black squares indicate populations of *Arceuthobium tsugense* subsp. *tsugense* sampled for morphological measurements and host susceptibility: British Columbia: 11—Spider Lake, 12—Texada Island, 13—Bowser, 14—Holt Creek, 15—Caycuse Summit.

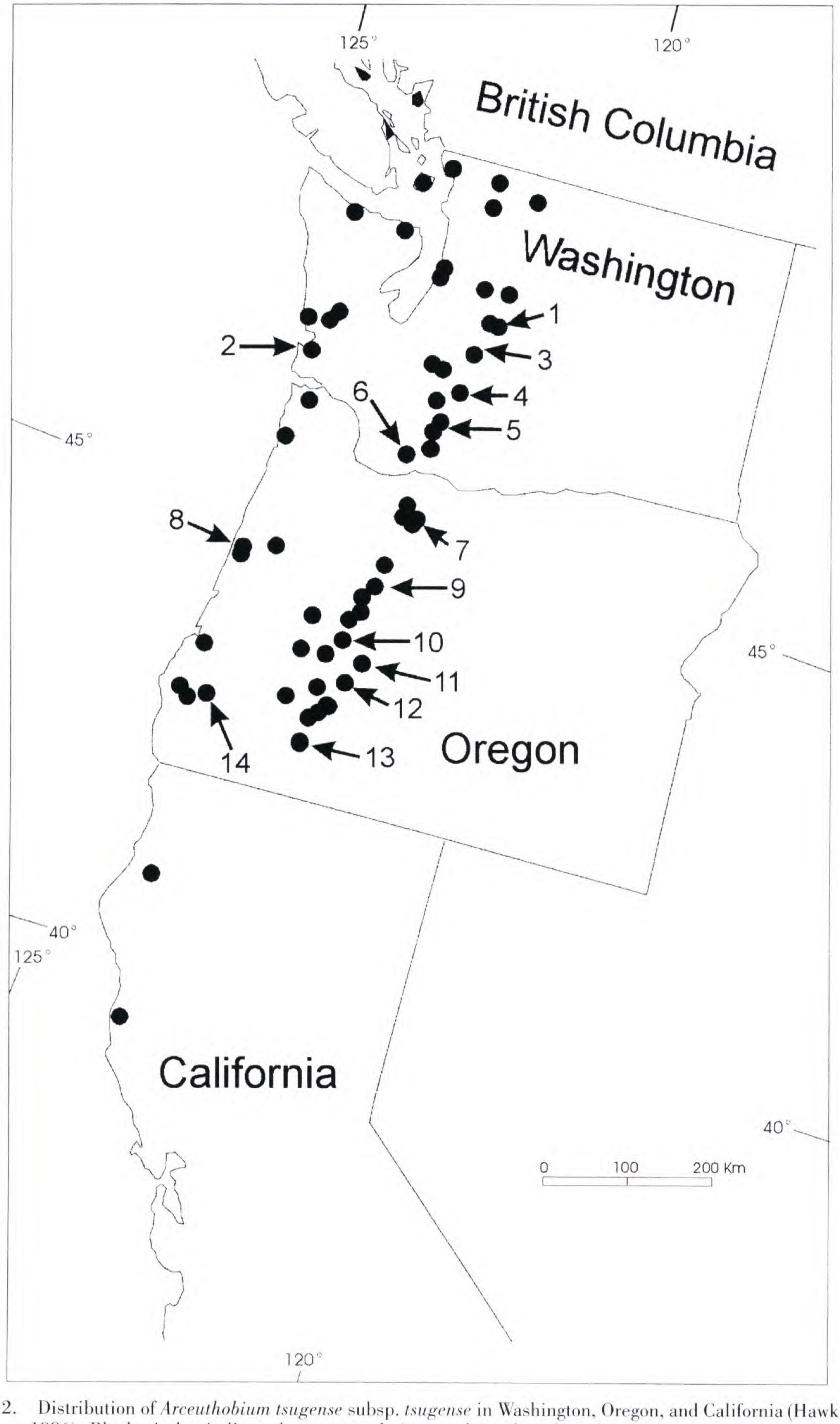

Figure 2. Distribution of *Arceuthobium tsugense* subsp. *tsugense* in Washington, Oregon, and California (Hawksworth & Wiens, 1996). Black circles indicate known populations and numbered circles indicate populations where mor-

Table 1. Morphological characteristics of male plants for shore pine and western hemlock dwarf mistletoes for collections from British Columbia and the United States.

	Shore pine dwarf mistletoe			Western hemlock dwarf mistletoe			Probability
Male plant characters*	Mean	Range	N/n**	Mean	Range	N/n	>F
Tallest shoot length	5.6	3.2–10.8	11/110	7.8	3.4–16.1	20/270	0.0001
Shoot basal diameter	2.8	1.7–4.7	11/110	2.6	1.3–5.0	20/269	0.2104
Shoot third internode length	9.2	5.8–15.7	11/110	11.8	4.5–23.0	20/270	0.0001
Shoot third internode width	1.8	1.1–2.5	11/110	1.6	0.8–3.0	20/270	0.0111
Third internode length/ width ratio	5.3	2.9–8.8	11/110	7.5	2.7–15.0	20/270	0.0001
Staminate spike length	12.6	5.0–22.0	11/110	10.8	5.0–27.4	16/260	0.1590
Staminate flower diameter	4.3	2.8–5.9	11/110	3.6	2.2–6.4	16/260	0.0056
Anther diameter	0.7	0.4–1.2	11/110	0.7	0.3–1.3	16/260	0.7650
Staminate perianth length	1.8	1.2–2.8	11/110	1.5	1.0–2.2	16/260	0.0015
Staminate perianth width	1.4	1.0–2.3	11/110	1.2	0.8–2.2	16/260	0.0248
Anther distance from perianth tip	0.9	0.4–1.5	11/110	0.5	0.2–1.2	16/260	0.0002

* Shoot length measured in cm; other characters measured in mm.
** N/n: number of populations sampled over number of individual measurements.

WHDM. Because we sampled several populations of both dwarf mistletoes and completed at least 100 measurements of the morphological characters selected for analysis, we feel the morphological differences we found between SPDM and WHDM are consistent and are taxonomically important discontinuities.

The principal host of shore pine dwarf mistletoe is clearly shore pine, and not western hemlock, which we classify as an occasional host of SPDM using the host susceptibility system of Hawksworth and Wiens (1972, 1996). When exposed to western hemlock dwarf mistletoe in mixed western hemlock/shore pine forests, shore pine is a rare host of this mistletoe. These large differences in susceptibility between these hosts represent distinct and consistent physiological discontinuities between these mistletoes and represent taxonomically important characters distinguishing them. Artificial inoculations also indicate that these large differences in host preference exist between SPDM and WHDM (Smith, 1974; Smith & Wass, 1979; Wass, unpublished).

Hawksworth and Wiens (1972, 1996: 146) defined subspecies in *Arceuthobium* as "geographically restricted populations delimited by a few relatively small but consistent variations." Although the distributions of the shore pine dwarf mistletoe and western hemlock dwarf mistletoe overlap, they have a few consistent morphological differences between them and clearly demonstrate different levels of parasitism on shore pine and western hemlock. Because of these morphological and physiological differences, the SPDM should be recognized as a subspecies of hemlock dwarf mistletoe based on Hawksworth and Wiens' concept of subspecies in *Arceuthobium*.

Furthermore, giving shore pine dwarf mistletoe taxonomic status at the subspecific level is consistent with the Hawksworth et al. (1992) classification of mountain hemlock dwarf mistletoe as a subspecies of hemlock dwarf mistletoe. Our field studies in the Calapooya Mountains of south central Oregon indicate that mountain hemlock dwarf mistletoe is not geographically restricted from populations of western hemlock dwarf mistletoe. In addition, only

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phological data was collected. Washington: 1—Snoqualmie Pass, 2—Westport, 3—Huckleberry Creek, 4—Cortright Creek, 5—Clearwater Creek, 6—Wind River Experimental Forest; Oregon: 7—Wapinitia Pass, 8—Desolation Saddle; 9—Huckleberry Creek, 10—Indigo Spring; 11—Wall Creek, 12—Calapooya Ridge, 13—Union Creek, 14—Iron Mountain.

Table 2. Morphological characteristics of female plants for shore pine and western hemlock dwarf mistletoes for collections from British Columbia and the United States.

Female plant characters*	Shore pine dwarf mistletoe			Western hemlock dwarf mistletoe			Probability >F
	Mean	Range	N/n**	Mean	Range	N/n**	
Tallest shoot length	6.6	4.0–9.5	11/110	8.0	3.8–13.7	20/265	0.0031
Shoot basal diameter	3.3	1.8–5.0	11/110	2.7	1.3–5.5	20/265	0.0214
Shoot third internode length	10.7	5.3–16.4	11/110	12.3	6.0–22.0	20/265	0.0050
Shoot third internode width	1.7	1.3–2.5	11/110	1.6	1.0–3.1	20/265	0.2584
Third internode length/ width ratio	6.2	3.6–9.4	11/110	7.8	3.3–16.0	20/265	0.0007
Fruit length	4.6	3.3–5.7	11/110	4.4	3.3–5.5	18/210	0.2058
Fruit width	3.1	2.1–4.2	11/110	2.9	2.2–3.5	18/210	0.0363
Seed length	2.5	1.8–3.0	10/100	2.6	1.8–3.5	17/200	0.1193
Seed width	1.4	1.0–1.7	10/100	1.1	0.8–1.4	17/200	0.0001

* Shoot length measured in cm; other characters measured in mm.
** N/n: number of populations sampled over number of individual measurements.

a few morphological and physiological differences distinguish these subspecies (Hawksworth et al., 1992; Hawksworth & Wiens, 1996). Differences in plant size, phenology, and host range are the principal characters used by Hawksworth et al. (1992) to separate those subspecies, and these are the same characters that distinguish shore pine dwarf mistletoe from western hemlock dwarf mistletoe (Table 3). Therefore, the classification of shore pine dwarf mistletoe as a subspecies of hemlock dwarf mistletoe, instead of a race, is more consistent with the interpretation for hemlock dwarf mistletoe proposed by Hawksworth et al. (1992) and with the taxonomic framework established in Hawksworth and Wiens' (1996) monograph of *Arceuthobium*.

Arceuthobium tsugense *subsp.* contortae. *Paratypes.* All citations based on *Pinus contorta* var. *contorta*. U.S.A. **Washington:** San Juan Co., summit of Mount Constitution, Orcas Island, 1921, *Beattie 5801* (FPF); summit of Mount Constitution, 1965, *Graham & Thompson s.n.* (FPF); Mount Constitution, near summit, 1972, *Hawksworth et al. 1442* (FPF); Moran State Park, Orcas Island, 1987, *Hawksworth 2211* (FPF); Little Summit, Orcas Island, 1997, *Mathiasen 9702* (ASC); summit of Mount Constitution, 1997, *Mathiasen 9703* (ASC); midway between

Table 3. Principal morphological and physiological differences between shore pine dwarf mistletoe (SPDM) and western hemlock dwarf mistletoe (WHDM).

Characters	SPDM	WHDM
Mean plant height:		
male	5.6 cm	7.8 cm
female	6.6 cm	8.0 cm
Mean length of third internode:		
male	9.2 mm	11.8 mm
female	10.7 mm	12.3 mm
Mean flower diameter	4.3 mm	3.6 mm
Mean seed width	1.4 mm	1.1 mm
Seed length to width ratio	1.8	2.4
Plant color:		
male	green-brown	yellow-green
female	green-brown	yellow-green/purple
Host susceptibility:		
shore pine	principal host	occasional host
western hemlock	rare host	principal host
Peak seed dispersal	one week earlier than WHDM	one week later than SPDM

Table 4. Infection of shore pine and western hemlock by shore pine dwarf mistletoe and western hemlock dwarf mistletoe.

		Shore pine		Western hemlock	
Dwarf mistletoe	Forest type	Trees sampled	Percent infected	Trees sampled	Percent infected
shore pine	pure shore pine	765	99	—	—
	shore pine and western hemlock mix	811	95	802	21
western hemlock	western hemlock and shore pine mix	77	1	138	96

Little Summit and Mount Constitution, 1997, *Mathiasen 9705* (ASC). CANADA. **British Columbia:** Vancouver Island, Metchosin, 1954, *Kuijt 602* (FPF); Vancouver Island, Horne Lake, 1954, *Kuijt s.n.* (FPF); Horne Lake, 1969, *R. S. Smith s.n.* (FPF); Horne Lake, 1977, *Hawksworth 1814* (FPF); Horne Lake, 1987, *Nickrent 2664* (FPF); Horne Lake, 1997, Vancouver Island, Courtenay, 1954, *Foster s.n.* (FPF); Vancouver Island, Goldstream, near summit of Mount Finlayson, 1965, *Ziller s.n.* (FPF); Vancouver Island, summit of Mount Finlayson, 1987, *Nickrent 2666* (FPF); Vancouver Island, Nanoose Bay, 1954, *Kuijt s.n.* (FPF); Savary Island, 1918, *Davidson s.n.* (FPF); Vancouver Island, Spider Lake, 6 km S of Qualicum, 1987, *Nickrent 2665* (FPF); Spider Lake, Lakeview Rd., *Wass 26851* (♂) and *26852* (♀) (DAVFP); mainland British Columbia, Sechelt, 1954, *Kuijt s.n.* (FPF); Sechelt, 1997 and 1998, *Wass 26861* (♂) and *26862* (♀) (DAVFP); Cortes Island, Mansons Landing, 1997, *Wass 26853* (♂) and *26854* (♀) (DAVFP); Vancouver Island, summit of Mount Helmcken, Victoria, 1997, *Wass 26855* (♂) and *26856* (♀) (DAVFP); Vancouver Island, summit of Bluff Mountain, Sooke, 1997, *Wass 26857* (♂) and *26858* (♀) (DAVFP); Vancouver Island, summit of Mount Work, Sidney, 1997, *Wass 26859* (♂) and *26860* (♀) (DAVFP); Vancouver Island, summit of Trap Mountain, Sooke, 1998, *Wass 26865* (♂) and *26866* (♀) (DAVFP); Texada Island, Mt. Pocahontas Rd., 1997 and 1998, *Wass 26863* (♂) and *26864* (♀) (DAVFP).

Arceuthobium tsugense *subsp.* tsugense. *Paratypes.* All citations based on *Tsuga heterophylla.* U.S.A. **Washington:** Skamania Co., Wind River Experimental Forest, 1998 and 2000, *Mathiasen 98125* (♀) and *0028* (♂) (ASC); Clearwater Creek, 1998 and 2000, *Mathiasen 98126* (♀) and *0029* (♂) (ASC); Lewis Co., Cortright Creek, 1998 and 2000, *Mathiasen 98127* (♀) and *0030* (♂) (ASC); Pierce Co., Huckleberry Creek, 1998 and 2000, *Mathiasen 98128* (♀) and *0031* (♂) (ASC); Kittitas Co., Snoqualmie Pass, 1998 and 2000, *Mathiasen 98129* (♀) and *0032* (♂) (ASC); Grays Harbor Co., Westport, 1998, *Mathiasen 98130* (♀) (ASC); Oregon: Jackson Co., NE of Union Creek, 1998 and 2000, *Mathiasen 98113* (♀) and *0034* (♂) (ASC); Douglas Co., Calapooya Ridge, 1998, *Mathiasen 98116* (♀) (ASC); Lane Co., Indigo Springs, 1998 and 2000, *Mathiasen 98118* (♀) and *0033* (♂) (ASC); Wall Creek, 1998 and 2000, *Mathiasen 98121* (♀) and *0035* (♂) (ASC); Huckleberry Creek, 1998 and 2000, *Mathiasen 98122* (♀) and *0036* (♂) (ASC); Wasco Co., Wapinitia Pass, 1998 and 2000, *Mathiasen 98124* (♀) and *0037* (♂) (ASC); Lincoln Co., Desolation Saddle, 1998, *Mathiasen 98131* (♀) (ASC); Coos Co., E of Iron Mountain, 1998, *Mathiasen 98132* (♀) (ASC). CANADA. British Columbia: Vancouver Island, Spider Lake, Qualicum Beach, 1997, *Wass 26869* (♂) and *26870* (♀) (DAVFP); Texada Island, Mt. Pocahontas Rd., 1997 and 1998, *Wass 26871* (♂) and *26872* (♀) (DAVFP); Vancouver Island, Holt Creek, Duncan, 1998, *Wass 26873* (♂) and *26874* (♀) (DAVFP); Vancouver Island, Caycuse Summit, Honeymoon Bay, 1997 and 1998, *Wass 26875* (♂) and *26876* (♀) (DAVFP); Vancouver Island, 1.2 km up Crosby Rd., Bowser, 1998, *Wass 26877* (♂) and *26878* (♀) (DAVFP).

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A New Species of the Genus *Tulipa* (Liliaceae) from China

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Abstract. *Tulipa mongolica* Y. Z. Zhao (Liliaceae) is described from Inner Mongolia, China. The new species is distinguished by its filaments 2.5–3.0 times as long as the anthers. It is related to *T. heteropetala* Ledebour on the basis of its filaments widened from the mid-point down, narrowing on both sides of the filament.

Key words: China, Inner Mongolia, Liliaceae, *Tulipa*.

The genus *Tulipa* L. contains about 150 species, about 14 of which are found in China. Among these there is only one species in Mongolia and Inner Mongolia. The two species *Tulipa heteropetala* and *Tulipa uniflora* (L.) Besser ex Baker have the closest relationship with this new species. The distribution of *Tulipa heteropetala* is in the north of Xinjiang, Siberia, and Central Asia. *Tulipa uniflora* occurs in Siberia and Central Asia.

The new species was referred to *Tulipa heteropetala* in Mao (1980) and *Tulipa uniflora* in Ninbu (1994). After comparing the features among these three species of *Tulipa* the author thought this species was new to science.

The new species was distributed solitarily over a sandy crack of volcanic cone in the XilinGol Meng of Inner Mongolia. The species is now extinct at the type locality because of heavy grazing pressure.

Tulipa mongolica Y. Z. Zhao, sp. nov. TYPE: China. Inner Mongolia: XilinGol Meng, Baiyinxile, 20 May 1979, *Shu-run Liu 395* (holotype, HIMC; isotypes, HIMC). Figure 1A–C.

Haec species *T. heteropetalae* Ledebour affinis, sed ab ea perianthii segmentis internis oblongo-obovatis, 2.5–4.5 cm longis apice acutis; filamentis 2.5–3.0-plo longioribus quam antheris atque pistillo longiore quam staminibus differt.

Perennial, 10–25 cm tall. Bulb ovate, 1–2 cm diam.; skin of bulb papery, dark brown, pubescent on inner surface; stem glabrous. Leaves 2, closely alternate, narrowly lanceolate, 8–11 cm long, 4–9 mm wide, often curved outward, glabrous. Flower single, terminal; perianth segments 6, in two series of 3, yellow, 2.5–4.5 cm long, 4–8 mm wide, apices acute; outer perianth segments 3, narrowly oblanceolate, externally green-purple; inner perianth 3, oblong-obovate, same length as above, 8–15 mm wide; stamens 6, in two series with 3 long, to 2.4 cm, and 3 short, to 2.2 cm long; filaments 2.5–3.0 times as long as anthers, yellow, glabrous, widened below their mid-point, gradually narrowed toward both sides; anther yellow, narrowly oblong, 4–6 mm long; pistil exceeding the stamens; style 1 cm long. Fruit and seed not found.

Habitat. On stony hillside fields.

Distribution. Inner Mongolia, XilinGol Meng, Baiyinxile.

Paratype. CHINA. **Inner Mongolia:** same locality as type collection, 8 May 1965, *Zhi-jie Xu 413* (HIMC).

The chief morphological differences between the new species and two similar species are summarized in the following key couplet. The three species of *Tulipa* also share in common a yellow flower, long style, and pubescence on the top of the inner skin of the bulb.

Key to the Three *Tulipa* Species in Inner Mongolia, China

1a. Only the base of the filaments of stamens widened, narrowing to the apex . . . . . 1. *T. uniflora* (L.) Besser ex Baker

1b. Filaments widened from the mid-point down, then narrowing on both sides of the filament.

2a. Stamen filaments equal in length to anthers or slightly longer; pistil shorter than stamens; inner perianth ovate to rhombic, 2–2.5 cm long, apex acuminate; leaves 2, loosely separate . . . . . 2. *T. heteropetala* Ledebour

2b. Stamen filaments 2.5–3.0 times as long as anther; pistil longer than stamens; inner perianth oblong to obovate, 2.5–4.5 cm long, apex acute; leaves 2, closely alternate . . . . . 3. *T. mongolica* Y. Z. Zhao

Paratype. CHINA. **Inner Mongolia:** XilinGol Meng, Baiyinxile, 8 May 1965, *Zhi-jie Xu 413* (HIMC).

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Figure 1. *Tulipa mongolica* Y. Z. Zhao. —A. Plant. —B. Skin of bulb. —C. Part of flower.

Note
Packera lyallii (Asteraceae: Senecioneae) Is a Superfluous Name

Abstract. *Packera contermina* is the correct name for the taxon erroneously published as *Packera lyallii*.

Key words: Asteraceae, *Packera*, Senecioneae.

My publication of the name *Packera lyallii* (Klatt) Bain (2002) was done in error, based on misinterpretation of Article 53.6 of the ICBN (Greuter et al., 2000).

Article 53.6 does not apply in the above case because *Packera lyallii* is a later homonym and is not a homonym of equal priority to which the article refers. *Packera contermina* (Greenman) Bain is therefore the correct name for this taxon, and *P. lyallii* is a superfluous name.

My argument for adopting the name *Packera cymbalarioides* (Nuttall) Weber and Löve to replace *Packera streptanthifolia* (Greene) Weber and Löve is based on a similar misinterpretation of Article 53.6 and is also incorrect.

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A New Hard Pine (*Pinus*, Pinaceae) from Taiwan

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Abstract. *Pinus fragilissima* Businský (Pinaceae), a new species of *Pinus* subg. *Pinus*, is described from southeastern Taiwan. Comprised of trees with very sparse crown and fragile, symmetrical, 6–9 cm long cones with often flat apophyses, it appears to be most closely related to *P. luchuensis* Mayr, endemic to the Nansei Islands, and to *P. taiwanensis* Hayata. The latter is circumscribed here as a Taiwan endemic with the exclusion of superficially similar but probably unrelated mainland Chinese pines. These three allied species are classified here as the sole representatives of *Pinus* subg. *Pinus* ser. *Luchuenses* E. Murray.

Key words: Pinaceae, *Pinus*, *Pinus* subg. *Pinus* ser. *Luchuenses*, Taiwan.

The author has been studying natural populations of Eurasian pines for more than ten years, concentrating on East Asia. The main object of the study is a taxonomic revision of *Pinus* in that region, the Revision of Pines of East Asia (REPEA) Project. Within the framework of this project, the author undertook a series of research expeditions to East Asia: eight to the People's Republic of China (1990–2001), two to Japan (1991 and 1997), two to Vietnam (1994 and 1997), and one to Taiwan (1991), Indonesia (1994), and the Philippines (2000). The study has been designed to obtain good field knowledge, above all of variability within and between populations, and to collect representative herbarium and photographic material of all Asian species of the genus *Pinus*, allowing a more uniform approach to classification (see also Businský, 1999).

Taxonomy

During an exploration in 1991 of forest stands in southern Taiwan, on the eastern (Pacific) side of the island's central mountain range, a remarkable population of a hard pine (= *Pinus* subg. *Pinus*) near Wulu village in the northern part of Taitung County was found. The only species known from Taiwan showing certain resemblance in general tree habit, external leaf characters, and some cone characters to this population is *Pinus massoniana* Lambert. Critchfield and Little (1966), using unpublished data at the Taiwan Forest Research Institute, reported *P. massoniana* only from northern Taiwan. However, Liu (1966) and Li (1975) also reported *P. massoniana* in the south, but only from the eastern coastal hills along the border between Taitung and Hualien Counties. Liu (1966: fig. 33) listed only one species of hard pine, *P. taiwanensis* Hayata, in the Wulu region. In a narrow taxonomic concept (excluding *Pinus hwangshanensis* W. Y. Hsia, see below), *P. taiwanensis* is confined to middle and high altitudes of Taiwan, widespread mainly between 2200 and 2900 m. However, the pine from the vicinity of Wulu occurs near or below 900 m, and differs from *P. taiwanensis* in several morphological characters (Table 1). No other indigenous hard pine is known from Taiwan. Outside of Taiwan, the Wulu population approaches *P. luchuensis* Mayr in some characters (leaf morphology and anatomy, distinctly broad tree crown); this is a species endemic to the nearby flat islands of the Nansei (Ryukyu) Archipelago, northeast of Taiwan (cf. Critchfield & Little, 1966; Yamazaki, 1995). The character set found in the Wulu pine is different from that of the three geographically closest spe-

cies: *P. massoniana*, *P. taiwanensis*, and *P. luchuensis*. The Wulu pine also cannot be equated with any other pine indigenous to East Asia, either; so as discussed below it is described here as a new species.

Pinus fragilissima Businský, sp. nov. TYPE: Taiwan. Taitung County: below the great bend of Southern Cross-Island Highway on S slopes about 1 km N of Wulu village, in mixed forest on W declivity of a stony ridge descending S, alt. 930 m, 23°10′40″N, 121°02′E, 18 Dec. 1991, *R. Businský 32172* (holotype, PR; isotypes, B, BM, C, G, MO, P, PE, TAI & Herbarium of the RILOG). Figure 1.

Arbor usque 30 m alta, corona conspicue sparse diffusa, lata; folia (12–)16–20(–22) cm longa, canalibus resiniferis 4 ad 6(7), plerumque medialibus et interdum (sub)marginalibus; strobili ovuliferi hornotini fere 9–10 mm lati, pedunculis 5–10 mm longis, squamis mucronatis praeter partem strobilorum basalem; strobili maturi (5–)6–9(–10) cm longi, fragiles, patentes vel leviter reflexi; apophyses plerumque prominentes, non tumidae. A *Pinus massoniana* differt imprimis canalibus resiniferis foliorum plerumque medialibus et umbonibus strobilorum maturorum plerumque prominentibus, non planis et concavis; a *P. taiwanensi* differt imprimis foliis longioribus, strobilis maturis longioribus, fragilibus et coronis arborum sparse diffusis; a *P. luchuensi* differt imprimis strobilis maturis longioribus et fragilibus, non suberectis, apophysibus plerumque pyramidalibus, non rotundatis vel tumidis et coronis arborum sparse diffusis.

Tall *trees* attaining a height of 30 m with conspicuously sparse crowns 20 m or more wide, branches spreading, remarkably frangible, with leaves falling during the second to third year. *Bark* developing late, initially irregularly scaly, on trunks of old trees conspicuously thick, deeply longitudinally fissured and forming ribs often around 10 cm thick. Annual *branches* uninodal, relatively long; shoots of the current year relatively thin (fertile shoots with conelets 3–6 mm thick), yellow-brown, initially slightly pruinose, glossy, with inconspicuous shallow and narrow grooves formed by the decurrent bases of the primary bracts; areolae among them low and relatively flat. Shoots of the previous year gray-brown. *Buds* cylindrical, up to ca. 3 cm long, with scales in the upper half loose to erecto-patent, narrowly lanceolate, with inconspicuous dorsal keel, brown in the middle, paler toward the lacerate margins, with long white fringes; scales not persistent at the bases of shoots. *Leaves* in fascicles of 2, occasionally in 3s on fertile shoots, (12–)16–20(–22) cm long, (0.9–)1.0–1.2(–1.35) mm wide (fresh), pale green, relatively fine and flexible, straight or slightly bent; amphistomatic; edges irregularly and rather densely acute-serrate, with (35 to)45 to 65(to 80) teeth per cm in the middle part; sheaths (8–)10–13(–15) mm long in the first year. Leaf resin ducts 4 to 6(7); two ducts near leaf edges always median, of largest diameter; 1 to 3(4) ducts dorsal, usually of smaller diameter, median or 1 to 2 of them marginal, occasionally submarginal, or near endodermis; usually one duct near the ventral side of small diameter, median to marginal (rarely larger and septal). Leaf hypodermis formed mostly by one layer of cells with relatively thin walls, sometimes a second layer in scattered patches on the dorsal side. *Pollen cones* ca. 2.5 cm long. *Ovulate cones* after the first growing season (conelets) on 5–10 mm long peduncles, 13–18(–20) mm long and ca. 9–10 mm wide, ovoid to elliptic cylindrical, erect, subterminal, usually in whorls of 3 to 5. The exposed part of the scales of the basal quarter of the conelet rounded, without a distinct keel or mucro; the other scales often show a considerably elevated area with a distinct transverse keel without discernible apex, dorsally depressed, with short mucro situated eccentrically on the ventral side, beginning from the swollen decurrent base and oriented backward over the keel. Mature *seed cones* spreading or slightly reflexed on slender 5–10 mm long peduncles, symmetrical, ovoid to oblong conical, fragile, (5–)6–9(–10) cm long, 5–8 cm wide when open; usually persistent for a few years, falling mostly without peduncle. Cone scales thin, densely arranged, 120 to 220, the largest 20–30 mm long and 12–15 mm wide, with length/width ratio 1.5–2.5, often broader below the middle than the apophysis width. *Apophyses* cinnamon brown, in outline irregularly transverse obtrullate, 11–14 mm wide, with rounded to broadly cuneate distal edge, ± broadly pyramidal (not rounded or tumid), with conspicuous, sharp transverse keel and generally concave, depressed proximal side (often with raised proximal corner). Umbo slightly sunken, but usually prominent, transverse, (2–)2.5–4(–4.5) mm wide on seed scales, pyramidal or rooflike, keeled, often depressed on the proximal side, with minute, slender, ca. 0.2–0.5 mm long, erect or recurved mucro. *Seeds* ca. 4–5.5 × 2.2–3 mm, with wings 11–25 × 4.5–7.5 mm.

Etymology. The specific epithet (denoting "fragilest") refers to the remarkably frangible branches and branchlets, more so than for all other East Asian pines, and to the fragile consistency of the scales of mature seed cones.

Distribution and Ecology

Pinus fragilissima was observed only in a relatively small valley system of the Hsinwulu River,

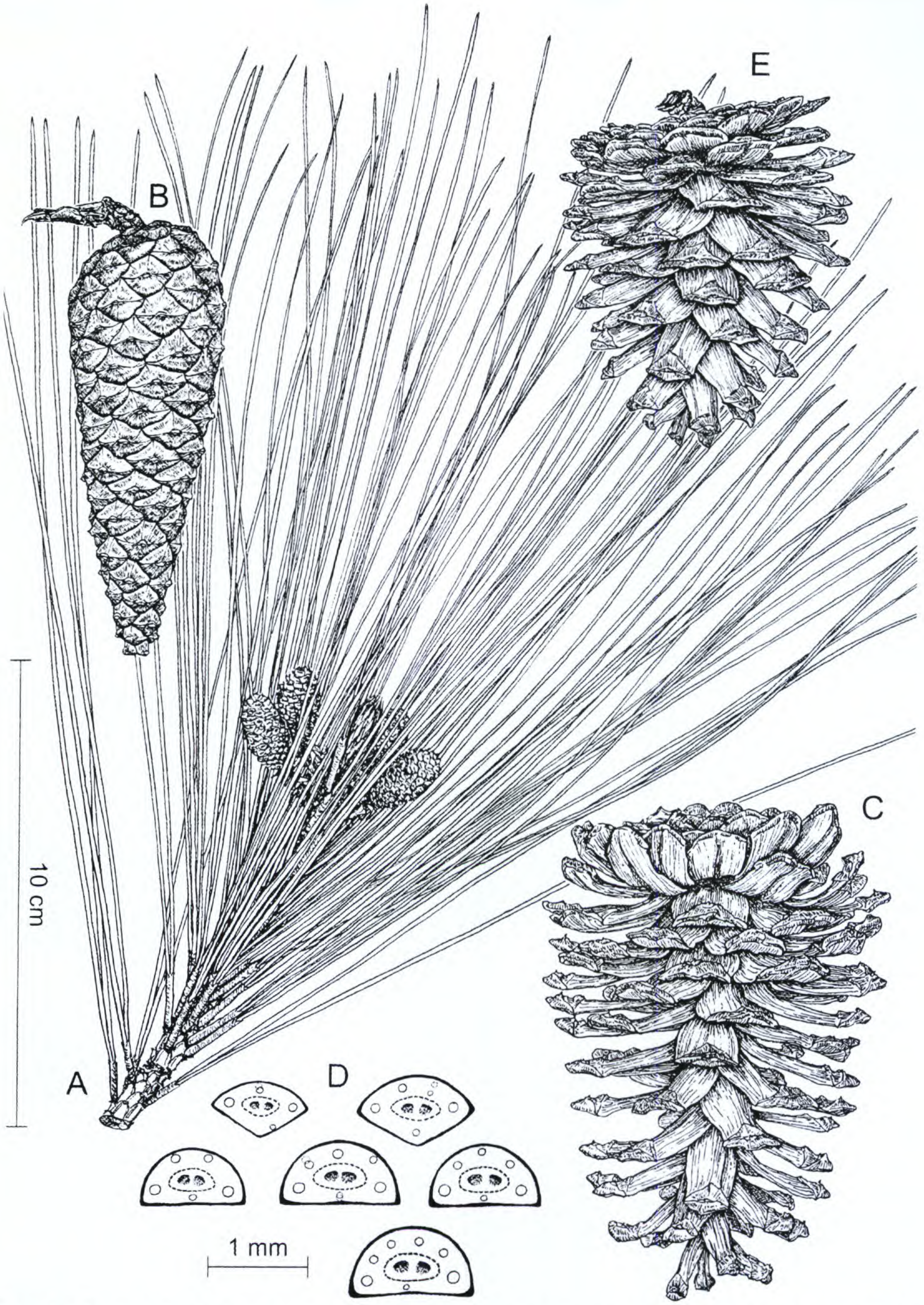

Figure 1. *Pinus fragilissima* Businský. —A. Fertile branchlet in winter season (current shoot, with top of previous year's shoot) with leaf fascicles, terminal bud and ovulate cones. —B. Mature closed cone. —C. Open seed cone. —D. Cross sections at the middle of leaves showing position of resin ducts. —E. Open seed cone of another individual. A–D from *R. Businský 32172*, holo- and isotypes, and E from *R. Businský 32173*, paratype. A, B, C, E: the same scale bar. All drawn by Ludmila Businská.

Table 1. Comparison of *Pinus fragilissima* with three morphologically most similar species: *P. taiwanensis*, *P. luchuensis*, and *P. massoniana* (compiled from the author's field collections of natural populations, see Appendix 1).

Character	*P. fragilissima*	*P. taiwanensis*	*P. luchuensis*	*P. massoniana*
Tree habit	tall trees with conspicuously sparse crown and spreading branches	usually tall trees with medium dense crown	usually low trees with relatively dense crown and conspicuously spreading branches	tall trees with medium dense crown
Leaf length (cm)	(12–)16–20(–22)	(6.5–)9–14(–17)	(7–)12–18(–21)	(10–)12–20(–22)
Number of leaf resin ducts	4 to 6(7)	4 to 6(7)	2 to 6(7)	(4)6 to 11(13)
Position of leaf resin ducts	largely median, some (sub)marginal	largely median, some (sub)marginal	median, rarely some internal or (sub)marginal	always marginal
Mature seed cone length (cm)	(5–)6–9(–10)	(4–)4.5–6(–8)	4–6(–6.5)	4–7(–9)
Mature seed cone symmetry	symmetrical	subsymmetrical or asymmetrical	symmetrical	symmetrical or subsymmetrical
Mature seed cone orientation	spreading or slightly reflexed	± reflexed	suberect to spreading	± reflexed
Consistency of mature seed cone scales	fragile	firm	fairly firm	rather fragile
Apophyses	± broadly pyramidal	broadly pyramidal or roundly prominent to tumid	± roundly prominent to tumid	flat or slightly, ± roundly prominent
Umbo	± pyramidal or rooflike, often with depressed proximal side	± pyramidal or rooflike, sometimes with depressed proximal side	± pyramidal	flat, generally concave as a whole

descending east-southeast from the Kuan Shan massif (3666 m) within the Chungyang Shanmo mountain region, in the vicinity of and below Wulu village in the northern part of Taitung County, Taiwan, on the eastern side of the island's central mountain range. The population of the new pine in the main valley of this system (i.e., along the Southern Cross-Island Highway) occurs in elevations between 500 and 1000 m, but it cannot be excluded that it reaches slightly higher altitudes in some of the side valleys of the system. The valley is characterized by steep, rocky slopes predominantly covered with broad-leaved woodlands. *Pinus fragilissima* prefers slopes of southern to western exposures, confined to rocky sites with reduced competition from broad-leaved trees. Potentially, the new pine may be found in suitable habitats in other less easily accessible valley systems in the Chungyang Shanmo mountains in Taitung and Hualien Counties.

Another population of pines occurs in similar altitudes eastward, opposite the slopes of the Chungyang Shanmo mountains, i.e., in a narrow belt of coastal hills (situated between ca. 23°00′ and 23°25′N) called Haian Shanmo. This population was identified as *Pinus massoniana* by Liu (1966) and Li (1975). Earlier on, Li (1963) cited a single specimen, *Tanaka 10453*, from southern Taiwan, at "Taitung," as *P. massoniana*. Liu's map (1966: fig. 31) of *P. massoniana* in Taiwan includes an isolated area in these coastal hills as a narrow strip about 60 km long following the main ridge of the range. A single dot representing a herbarium specimen is in the middle of this strip, in the vicinity of Mt. Xingang Shan (1682 m, on the border of Taitung and Hualien Counties, above the port of Chengkung), about 20 km east of the observed site of *P. fragilissima* in the Hsinwulu valley. No herbarium specimens are cited by Liu, but Li (1963) is cited, and thus it is presumed here that the dot refers to the specimen cited by Li (*Tanaka 10453*). A duplicate of *Tanaka 10453* (C), determined as *P. massoniana* by the collector, was examined and undoubtedly is *P. fragilissima*; consequently the whole population of pines in the Haian Shanmo is considered here belonging to this species. This mountain range reaches the highest elevation in Xingang Shan, which is close to the Hsinwulu River system. The region with *P. fragilissima* as a whole is characterized by dry winters and wet summers (Walter & Lieth, 1964: part 2.4).

Paratypes. TAIWAN. Taitung County, below the great bend of Southern Cross-Island Highway on S slopes about 1 km N of Wulu village, in sparse mixed forest on S stony declivity, alt. 930 m, 23°10′40″N, 121°02′E, 18 Dec. 1991, *R. Businský 32173* (PR); Tai tô-chô [Taitung], Kaede, 7 Mar. 1931, *T. Tanaka 10453* (C).

Discussion

Pinus fragilissima is similar to *P. luchuensis*, particularly in leaf size and anatomy. However, they otherwise differ morphologically and in their ecological requirements. The new species differs from *P. massoniana* in several characters, notably in the position of the resin ducts, a character usually given as important in the classification and determination of the Asian hard pines (cf. Gaussen, 1960; Kwei & Lee, 1963; Cheng et al., 1975; Law et al., 1978). On the other hand, both species occupy a similar altitudinal range; according to Liu (1966) and Mirov (1967), *P. massoniana* in Taiwan is confined to 300–1300 m. The new species is distinct from *P. taiwanensis* in general habit (sparse broad crowns), but further differences exist in leaf length, cone size, and scale fragility. Although both species occur in the same mountain region, their altitudinal ranges are different and barely overlap. The altitude of 750 m recorded as the lower limit for *P. taiwanensis* by Li (1963: 51), Liu (1966: 17), and Mirov (1967: 284) is in conflict with field observations of the present author in several regions. Even isolated trees of *P. taiwanensis* below its main zone of occurrence were above 1500 m in most of these regions. The 750 m record may be a result of the inclusion of *P. fragilissima* or *P. massoniana* in the distribution of *P. taiwanensis*. Sheue et al. (2000) analyzed variation of leaf anatomy attributed to *P. taiwanensis* in the Tachia river system (mainly in Taichung County on the west side of northern Taiwan) in five localities from an altitude of 700 m (Kukuan) to 3100 m (Konankaun). Li (1963, 1975) and Liu (1966) reported from this region also an occurrence of *P. massoniana*. The present author studied pine populations and collected samples of trees in the Tachia river system in the mentioned altitudinal range as well. The population of a hard pine in the vicinity of Kukuan (occurring between 500 and 1000 m) is, however, considered to be *P. massoniana*, comprising also some individuals morphologically transitional to *P. taiwanensis* (probably of hybrid origin). On the basis of a suite of morphological and anatomical characters, ranges of variability, and the geographic distribution, the trio of *Pinus luchuensis*, *P. taiwanensis*, and *P. fragilissima* appears as a related group, accepted here as the series *Luchuenses* E. Murray within the typical section and subsection of the genus.

Some Chinese authors, e.g., Law et al. (1978) and Fu and Li in Fu et al. (1999), include mainland populations described (and accepted here) as *Pinus*

hwangshanensis W. Y. Hsia in *P. taiwanensis*. However, *P. hwangshanensis* appears more closely related to the Japanese *P. thunbergii* Parlatore (Wang & Szmidt, 1993). Field and herbarium studies of *P. hwangshanensis* (see Appendix 1) show it to be different from *P. fragilissima* in general habit, morphology, and anatomical characters, and also in ecological requirements. While *P. hwangshanensis* prefers exposed rocks on the tops and ridges of continental mountains predominantly above 900 m, *P. fragilissima* prefers sheltered rocky sites in valleys of (sub)coastal mountains predominantly below 900 m.

KEY TO THE SPECIES MORPHOLOGICALLY SIMILAR TO *PINUS FRAGILISSIMA*

1. Leaves with resin ducts always marginal, usually less than 1 mm wide and more than 12 cm long; apophyses of seed cones relatively thin, flat or slightly prominent, umbo flat and generally concave as a whole, with indistinct or depressed transversal keel . . . . . *P. massoniana*
1′. Leaves with resin ducts only or largely median, often more than 1 mm wide or less than 14 cm long; apophyses of seed cones usually broadly pyramidal or roundly prominent to tumid, umbo prominent (although sometimes sunken), generally pyramidal and pointed or rooflike (sometimes ± depressed on the proximal side or on the top), with distinct and usually raised transversal keel 2
2(1). Leaves of mature trees (7–)12–20(–22) cm long; seed cones generally symmetrical, early deciduous or persistent for a few years; branchlets remarkably frangible; species of flat islands, hills, and submontane valleys; only or predominantly below an altitude of 900 m 3
2′. Leaves of mature trees (4–)5–14(–18) cm long; seed cones generally asymmetrical, usually firmly persistent for more years; branchlets relatively firm; species of mountain tops, ridges, and slopes, predominantly above an altitude of 900 m 4
3(2). Bud scales persistent at the bases of shoots; mature seed cones suberect to spreading, 4–6 (–6.5) cm long, with apophyses ± roundly raised, usually at first pruinose; usually low trees with relatively dense crown . . . *P. luchuensis*
3′. Bud scales not persistent at the bases of shoots; mature seed cones spreading or slightly reflexed, (5–)6–9(–10) cm long, with apophyses ± pyramidally prominent, not pruinose; tall trees with conspicuously sparse crown . . . . . *P. fragilissima*
4(2). Apophyses of seed cones usually light brown, not contrasting in color with indistinct sealing band on scales, proximal side of apophyses generally convex (sometimes convex only near umbo and concave toward the proximal apophysis corner), umbo ± sunken but not flat . . . . . *P. hwangshanensis*
4′. Apophyses of seed cones usually cinnamon brown, contrasting in color with distinct, lighter sealing band on scales, the proximal side of apophyses generally concave (sloped almost from the umbo, sometimes with raised proximal apophysis corner), umbo usually not sunken . . . . . *P. taiwanensis*

Note. R. R. Mill in the *Flora of China* (Fu et al., 1999) gave the following diagnostic characters of *Pinus hwangshanensis* and *P. taiwanensis*: length of needle sheaths, number of teeth per cm in the middle part of needle margins, color of pollen cones, and umbo morphology of seed scales. These characters, except for color of pollen cones, were tested by the author in detail in 44 individuals of the former species and in 32 of the latter, in both cases from several regions (see Appendix 1 for herbarium material examined). Only the umbo morphology was found partly in correspondence with Mill (in Fu et al., 1999)—i.e., umbo sunken ("depressed") but not flat versus not sunken ("not flat"). The difference in quality of mucro ("prickle") reported there was not found. Moreover, both leaf characters were found entirely insignificant for discrimination between these species. That is to say: the reported number of teeth does not agree for *P. taiwanensis* (it does not even correspond with both the type specimens), with the found range of (25–)32–55(–70), not "26–35(–39)"; the reported length of sheaths does not agree, either, for *P. hwangshanensis*, with the found range of (6–)10–14(–17) mm, not "0.5–1 cm" (sheaths longer than 12 mm were found in populations in the Dabie Shan Mts. north of the Yangtze River).

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Appendix 1. Herbarium Material Examined

HERBARIUM SAMPLES COLLECTED:

List of herbarium samples collected by the author is ordered chronologically below according to localities where natural populations of relevant species were studied and representative trees sampled (month, year, and collection numbers are in brackets; R. B. is an abbreviation of R. Businský). Collections listed are stored in the herbarium of the Silva Tarouca Research Institute for Landscape and Ornamental Gardening (RILOG), 252 43 Průhonice, Czech Republic.

Pinus taiwanensis Hayata:

- Central Cross-Island Highway SSE near Lishan, Nantou Co., Taiwan; alt. about 2050 m [Nov. 1991: *R. B. 32137*]
- Hsuehshan massif (3884 m), SE slopes, Taichung Co., Taiwan; alt. 2400–3400 m [Nov./Dec. 1991: *R. B. 32140, 32141a–d, 32142, 32144a–i*]
- Central Cross-Island Highway at Tayuling, Hualien Co., N part, Taiwan; alt. about 2600 m [Dec. 1991: *R. B. 32146, 32147, 32148, 32158, 32159*]
- Along the road from Tayuling to Wushe, Nantou & Hualien Co. boundary, N part, Taiwan; alt. 2700–3200 m [Dec. 1991: *R. B. 32152, 32153, 32154, 32155*]
- Both sides of central ridge along the Southern Cross-Island Highway, Kaohsiung & Taitung Co., Taiwan; alt. 2600–2800 m [Dec. 1991: *R. B. 32164, 32165, 32166, 32167*]

Pinus luchuensis Mayr:

- Naha City suburbs, Okinawa Island, Nansei Islands, Japan; alt. 20–30 m [Nov. 1991: *R. B. 32120, 32121, 32122, 32123, 32124*]
- Ishigaki town environs, Ishigaki Island, Nansei Islands, Japan; alt. 80 m [Nov. 1991: *R. B. 32125, 32126, 32127*]

Pinus massoniana Lambert:

- Kukuan environs, Tachia valley, Taichung Co., Taiwan; alt. 500–1000 m [Nov. 1991: *R. B. 32131, 32132, 32133*]
- Lechang Co., Guangdong, China; alt. 900–1200 m [Jan. 1994: *R. B. 39121, 39124, 39125*]
- Xingshan Co., W Hubei, China; alt. about 1400 m [July 1995: *R. B. 42115*]
- Tianzhu Shan massif (1488 m), Qianshan Co., SW Anhui, China; alt. 300–700 m [July 1995: *R. B. 42116*]
- Longming environs, Tiandeng Co., SW Guangxi, China; alt. 500 m [Aug. 1998: *R. B. 46121, 46122, 46123*]
- Between Longming & Shangying, Tiandeng Co., SW Guangxi, China; alt. 600 m [Aug. 1998: *R. B. 46124*]
- Daming Shan Mts., S slopes, Wuming Co., Guangxi, China; alt. 400–1000 m [Sep. 1998: *R. B. 46126, 46127*]
- Laibang environs, Dabie Shan Mts., Yuexi Co., Anhui, China; alt. 700 m [Sep. 1998: *R. B. 46134*]

Pinus hwangshanensis W. Y. Hsia:

- SW boundary of Rucheng Co. (Hunan) with Guangdong, China; alt. 1500 m [Jan. 1994: *R. B. 39126, 39128, 39129*]
- Tianzhu Shan massif (1488 m), Qianshan Co., SW Anhui, China; alt. 600–1450 m [July 1995: *R. B. 42117, 42118, 42119*]
- Miaodao Shan massif (1432 m), Yuexi Co., SW Anhui, China; alt. 800–1400 m [July 1995: *R. B. 42120, 42121*]
- Mt. Tiantangzhai (1729 m), Yingshan Co., E Hubei, China; alt. 700–1500 m [July 1995: *R. B. 42124, 42125, 42126*]
- Yaoluoping environs, Dabie Shan Mts., Yuexi Co., Anhui, China; alt. 900–1300 m [Sep. 1998: *R. B. 46135, 46141, 46142, 46143*]
- Between Laibang and Huo Shan massif, Dabie Shan Mts., Yuexi Co., Anhui, China; alt. 1300 m [Sep. 1998: *R. B. 46144, 46145*]

Pinus fragilissima Businský—additional field label information:

R. Businský 32172 (holotype)—old tree with 270 cm trunk circumference (at 1.3 m height), 23 m high, crown about 20 m in diameter

R. Businský 32173 (paratype)—old tree with 220 cm trunk circumference, branches to 12 m long

OLDER SPECIMENS EXAMINED:

Pinus hwangshanensis W. Y. Hsia:

K. K. Tsoong 4495: Anhwei [= Anhui], Hwangshan; 9.10.**1924.** Det. as *P. hwangshanensis* by W. Y. Hsia. [PE]

M. Chen 703: Chekiang [= Zhejiang], Tianmu Shan; 1.7.**1933.** Det. as *P. tabulaeformis* Carr. by? W. C. Cheng, and as *P. hwangshanensis* by W. Y. Hsia. [PE]

M. Chen 1267: Anhwei [= Anhui], Hwangshan, Shizi

Feng, 6200 ft.; 4.10.**1933.** Det. as *P. tabulaeformis* Carr. by W. C. Cheng, and as *P. hwangshanensis* by W. Y. Hsia / H. H. Hu. [PE: two specimens]

H. H. Hu 2621: Kiangsi [= Jiangxi], [Jiujiang Co.], Lu Shan, Kuling [= Guling], trees 30–40 m high; Aug. **1934.** Det. as *P. tabulaeformis* Carr. by H. H. Hu, and as *P. hwangshanensis* by W. Y. Hsia in 1936. "Paratype." [PE]

P. C. Tsoong 3111: Anhwei [= Anhui], Hwangshan, Hsi-hai-men; coll. N. T. Liou & P. C. Tsoong, 28.8.**1935.** Det. as *P. hwangshanensis* by W. Y. Hsia. [PE]

P. C. Tsoong 3461: Anhwei [= Anhui], upper slope of Mt. Tientu near summit; 13.6.**1936.** Det. as *P. hwangshanensis.* [PE]

P. C. Tsoong 3919: Anhwei [= Anhui], on approaching Shin-Jin, in wood; 9.7.**1936.** Det. as *P. thunbergii*, and later, in 1956, as *P. hwangshanensis.* [PE]

X. Y. He 30300: Zhejiang, Tianmu Shan; **s. a.** Det. as *P. hwangshanensis* in 1964. [In Chinese; PE: specimens of five individuals]

P. taiwanensis Hayata:

T. Kawakami & U. Mori 2097: Taiwan, Central Mts; Nov. **1906.** Lectotype of *P. taiwanensis* Hayata, designated by A. Farjon, 4.3.1992. [TI]

B. Hayata & U. Mori 7142: Taiwan, Randaizan; 9.8.**1908.** Syntype of *P. taiwanensis* Hayata. [TI]

U. Mori, s. n.: Taiwan; **s. a.** Type of *P. brevispica* Hayata. [TI]

A New *Jacquinia* (Theophrastaceae) from the Yucatán Peninsula with a Synopsis of Pale-Flowered Species in Mesoamerica

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ABSTRACT. A synopsis of Mesoamerican *Jacquinia* (Theophrastaceae) species with white, yellowish, or cream-colored flowers is presented. A key for their identification is provided. All of these species are restricted to northern Mesoamerica. Among these taxa *Jacquinia sak-lol* Carnevali, Hernández-Aguilar & Tapia-Muñoz, from the state of Quintana Roo in the Mexican Yucatán Peninsula, is proposed as new. The new entity is described and illustrated. The proposed novelty is related to *Jacquinia paludicola* Standley, but it is a shrub and features smaller, more coriaceous leaves with a revolute margin and larger flowers.

RESUMEN. Se presenta una sinopsis de las especies de *Jacquinia* (Theophrastaceae) de Mesoamérica con flores blancas, amarillentas o color crema. Se provee una clave para su identificación. Estas especies están restringidas al norte de Mesoamérica. Entre ellas, *Jacquinia sak-lol* Carnevali, Hernández-Aguilar & Tapia-Muñoz del estado de Quintana Roo en la Península de Yucatán Mexicana es propuesta como nueva. La nueva entidad es descrita e ilustrada. La nueva especie es afín a *Jacquinia paludicola* Standley pero es un arbusto, tiene hojas de tamaño menor y de textura más coriácea con el margen revoluto y flores mayores.

Key words: *Jacquinia*, Mexico, Theophrastaceae, Yucatán.

The genus *Jacquinia* L. (Theophrastaceae), comprising 35 to 38 species, was recently revised by Ståhl (1989, 1995). A synopsis of Central American taxa was published shortly thereafter (Ståhl, 1989), in which 11 species within Mesoamerica were recognized. Later, a somewhat aberrant species, *Jacquinia nemophila* Pittier, restricted to Panama and featuring larger, thinly textured green flowers and large, wide leaves, was transferred to a new genus, *Votschia* Ståhl. This action reduced the number of Central American *Jacquinia* to 10 (Ståhl, 1993). An additional species, *J. morenoana* Castillo-Campos & E. Medina, was recently described from the state of Veracruz in Mexico (Castillo-Campos & Medina, 1998).

Many species of *Jacquinia* are typically characterized by brightly colored red or orange flowers. Among the Mesoamerican *Jacquinia* taxa treated by Ståhl (1989), five were described as having flowers of other, paler colors, namely white or pale yellow. As Ståhl (1989) suggested, when discussing *J. albiflora* Lundell this difference in flower color may indicate a different pollinator fauna, although we have no information on pollinators and floral biology of these species.

In Mesoamerica, the taxa of *Jacquinia* with white or yellowish flowers are concentrated in the northern half. No *Jacquinia* species with pale-colored flowers are known from Costa Rica or Panama, although there are several in the West Indies and one, *Jacquinia armillaris* Jacquin, occurs in northern South America (Ståhl, 1995). Nicaragua, which is the southernmost limit for pale-colored *Jacquinia* species in Mesoamerica and where four *Jacquinia* species are known to occur, harbors one pale-flowered taxon, *J. longifolia* Standley, the most widespread and variable of the taxa treated in this account (Ståhl, 2001). On the other hand, Belize, where another set of four *Jacquinia* taxa have been reported (Balick et al., 2000), is home to three pale-flowered species of the genus, suggesting an increase in species diversity with these floral colors toward the north of Central America.

The center of diversity of these pale-flowered *Jacquinia* in Mesoamerica is the Yucatán Península Biotic Province, where all the known Mesoamerican pale-flowered taxa of the genus occur. The Yucatán Península Biotic Province was defined in Durán et al. (1998) and somewhat differently by Carnevali et al. (2001) as including the three Mexican states of Yucatán, Campeche, and Quintana Roo besides the Petén Department of Guatemala, and the three northernmost districts of Belize, namely, Belize, Corozal, and Orange Walk. Here (Trejo-Torres & Hernández-Aguilar, pers. comm.) seven species of *Jacquinia* occur (including the novelty proposed

herein), five of which feature blossoms in the hues of white, pale yellow, or cream-color and are the subject of this account.

The pale-flowered *Jacquinia* species in Mesoamerica include considerable variation in vegetative architecture, leaf shape, inflorescence length, flower shape, and habitat preferences (see Ståhl, 1989, and comments below). For example, *Jacquinia arborea* and *J. longifolia* have white flowers that are a smaller version of the orange-red flowers of *J. macrocarpa* Cavanilles with the free portions of the petals ("corolla lobes") diverging from the tube (which in this case is totally hidden inside the calyx) immediately above the calyx lobes. Furthermore, the staminodes are petal-like and only somewhat smaller than the corolla lobes, thus giving the effect of a widely opening, 10-lobed corolla (or with two series of perianth whorls, one larger than the internal one). The stamens are exserted. *Jacquinia albiflora* has flowers similar in shape to those of the two taxa above, but instead of having the obovate, obtuse leaves found in them, it features narrowly elliptic leaves, and the staminodes are more petal-like.

On the other hand, *J. paludicola* and *J. sak-lol* have a short but definite corolla tube exserted beyond the calyx apex. The stamens are inserted in the corolla tube. The staminodes are much smaller than the petals, anther-like, with the apices thickened, the bases cordate or subcordate, and a general anchor-like outline. They are either inserted in the corolla mouth or barely protruding. Since there is an exserted corolla tube and the staminodes are relatively small and different from the petals, the flowers have a rotate, 5-lobed corolla.

Thus, the Mesoamerican pale-flowered taxa of *Jacquinia* appear to belong in different species groups, suggesting that the floral color feature has evolved independently several times in the genus. A cladistic analysis of *Jacquinia* would be required to address the question of a single or multiple origins of the floral colors found in the genus.

The five Mesoamerican *Jacquinia* taxa with pale-colored flowers can be distinguished with the following key:

Key to Mesoamerican *Jacquinia* Species with Pale-Colored Flowers

1a. Leaves obovate or obovate-spathulate, apex rounded, with or without a terminal spine (most commonly this lacking).
  2a. Young branches densely lepidote; leaves thick, coriaceous, the margin revolute; inflorescences as long as to longer than the leaves . . . . . 2. *J. arborea*
  2b. Young branches glabrous or puberulent; leaves thin, thickly membranous, the margin flat; inflorescences much shorter than leaves . . . . . 3. *J. longifolia*

1b. Leaves elliptic or narrowly elliptic, acute, always with well-developed terminal spines.
  3a. Leaves less than 1.5 cm wide, narrowly elliptic; inflorescences composed of (2)3- to 7(9)-flowered racemes; rachis conspicuous; many branchlets flowering simultaneously; corolla campanulate, up to 7.5 mm long; staminodes exserted; staminodes petaloid . . . . . 1. *J. albiflora*
  3b. Leaves 1.7–4 cm wide, elliptic; inflorescences composed of short 1- to 3-flowered racemes or several-flowered fascicles; rachis inconspicuous, always shorter than the peduncle, few branchlets flowering at any given time; corolla campanulate or tubular-rotate, usually longer than 8.5 mm long; stamens inserted or barely protruding at corolla mouth; staminodes ± stamen-like, i.e., the apical portion thickened and differently shaped than the basal portion.
    4a. Sparsely branched shrub 0.8–3 m tall; leaves thickly coriaceous, 4.5–8.5 cm long, 1.7–3.3 cm wide, margins revolute; inflorescence composed of a short, 2- to 4-flowered raceme or pseudoumbel; pedicels 7.9–8.1 mm long; corolla deeply tubular, (7.5–)9–10 mm long; stamens inserted within the tube . . . . . 5. *J. sak-lol*
    4b. Much-branched trees 3–10 m tall; leaves thinly coriaceous, 10–14 cm long, 3.1–4.5 cm wide, margins flat; inflorescence composed of a 4- to 8-flowered raceme or pseudoumbel; pedicels 9–11 mm long; corolla campanulate or shortly tubular, 6 mm long; stamens barely protruding at corolla mouth . . . . . 4. *J. paludicola*

Synopsis of the Mesoamerican *Jacquinia* Species with Pale-Colored Flowers

Jacquinia L., Diss. Fl. Jam. App. 1759. TYPE: *Jacquinia ruscifolia* L.

1. Jacquinia albiflora Lundell, Wrightia 2: 60. 1960. *Jacquinia aurantiaca* var. *albiflora* (Lundell) Lundell, Wrightia 3: 114. 1964. TYPE: Guatemala. Petén: Tikal National Park, Tikal, in low forest on top of Temple III, 29 July 1959, *E. Contreras 45* (holotype, LL not seen; isotypes, MO photocopy, S not seen, TEX not seen, US).

Among other pale-flowered species in the area covered, *Jacquinia albiflora* is easily recognized by the combination of 3- to 7-flowered racemes produced on relatively long peduncles (10–25 mm long) and the relatively small leaves, these 2.2–3.8(4.8) cm long (average: 3.26, standard deviation: 0.55, $n = 55$), 0.6–1.2(1.5) cm wide (average 0.99,

standard deviation: 0.20, $n = 55$). The relatively long peduncles allow for inflorescences that are commonly about as long as to longer than the leaves. The leaves are elliptic or narrowly elliptic and are seldom wider than 1.2 cm (rarely up to 1.5 cm wide). The species is endemic to the Yucatán Península Biotic Province (as defined in Carnevali et al., 2001). The flowers are white, eventually fading into pale yellow upon aging. Specimens of *Jacquinia albiflora* are commonly mistaken for *J. macrocarpa* Cavanilles, but in *J. macrocarpa* flowers are red or orange-red and the leaves are much larger and proportionally wider with a range of dimensions of (2.9)3.5–5.5(6.5) cm long (average: 4.14, standard deviation: 0.98, $n = 109$) and (1.0)1.3–1.8(2.0) cm wide (average: 1.52, standard deviation: 0.44, $n = 109$). *Jacquinia albiflora*, with its relatively long inflorescences and many simultaneously opening flowers that are similar to those of *J. macrocarpa*, albeit smaller, is most probably related to this taxon rather than to other pale-flowered taxa.

The specimen *C. Cowan 3009* (CICY, CSAT, MEXU), from "Bajo de Morocoy al E de Nicolas Bravo, carretera Escarcega-Chetumal, México," is atypical in displaying larger leaves of a thinner texture. The population represented by this collection is tentatively referred to *J. albiflora* until a more thorough sampling of its variation is available. It may represent a different (perhaps undescribed) species.

Jacquinia albiflora has the following floral dimensions: calyx lobes 1.5–2 mm long, 1.5–2 mm wide; corolla tube inserted within the calyx 1.5–2 mm long, the corolla lobes ca. 3 mm long, 2 mm wide; the staminodes are 1.5 mm long and wide; stamens 1.8–2 mm long, filaments 0.9–1 mm long, anthers ca. 1 mm long.

Distribution and habitat notes. *Jacquinia albiflora* has been reported from the Mexican states of the Yucatán Peninsula (Campeche, Quintana Roo, and Yucatán), in the Guatemalan Petén, and in northern Belize. It is usually a heavily branched shrub 1–2.5 m tall. It grows in several kinds of ecosystems, but most collections have been made in low inundated forests or "tintales," at elevations of 0–250 m. Most flowering collections have been made in April to July, while fruiting collections have been made from May until November.

Representative specimens examined. GUATEMALA. **Petén**: Tikal National Park, 12–15 Apr. 1931, *H. H. Bartlett 12594* (A), 24 Apr. 1971, *R. Tun Ortiz 1723* (US); in ramonal covering the ruins, 20 Apr. 1968, *E. Contreras 7716* (US); Aguada Naranjal on Arroyo Corriental, 10 Feb. 1959, *C. L. Lundell 15461* (GH); on top of Temple III, 30 Jan. 1964, *C. L. Lundell 17613* (GH); 4 km NO de Uaxactún, 18 May 1973, *R. Tun Ortiz 2588* (US); San Clemente to Dos Arroyos, 1 May 1931, *H. H. Bartlett 12821* (A, US). MEXICO. **Campeche**: Municipio Campeche, Crucero de P. Trueba y autopista, Ciudad de Campeche, 19°48′15″N, 90°31′30″W, 8 m, selva baja caducifolia secundaria, 2 Apr. 2000, *C. Gutiérrez B. 6802* (CICY, UCAM), 28 Oct. 2002, *G. Carnevali et al. 6557* (CICY, NY); Municipio Calakmul, 500 m al N del poblado 11 de Mayo, 18°05′52″N, 89°27′42″W, 4 May 1998, *E. Madrid et al. 813* (CICY, MEXU); Municipio Calakmul, 59 km N of Xpujil, camino a Xcan-ha, 18°59′51″N, 89°18′04″W, 9 Apr. 1998, *E. Martínez et al. 30615* (MEXU); 2 km al NE de Calakmul, 18°27′24″N, 89°47′25″W, 8 Aug. 1997, *E. Martínez et al. 28188* (MEXU); a 6 km al S de la entrada a Calakmul, 18°26′39″N, 89°26′39″W, 120 msnm, 16 Oct. 1997, *E. Martínez S. et al. 28851* (MEXU); a 8 km al NE de Bel-ha, 18°57′38″N, 89°14′42″W, 9 Apr. 1998, *E. Martínez S. et al. 30588* (MEXU). **Quintana Roo**: Municipio Othón P. Blanco, Ejido Caobas, aprox. 18°47′18″N, 88°59′47″W, 28 Apr. 1999, *G. Carnevali et al. 5433* (CICY, MEXU); Lake Chichankanab, Apr. 1917, *F. Gaumer 23653* (GH, US). **Yucatán**: Municipio Valladolid, parte Sur-este del ejido San Lorenzo perteneciente al pueblo de Pixoy, 20°42′28″N, 88°15′41″W, 21 Apr. 1983, *E. Ucán 2410* (CICY).

2. Jacquinia arborea Vahl, Ecol. Amer. 26: 26. 1796. *Jacquinia armillaris* var. *arborea* (Vahl) Grisebach, Fl. Brit. West.-Ind. Isl. 397. 1861. TYPE: Lesser Antilles. Monserrat: *J. Ryan s.n.* (lectotype, designated by Ståhl (1992: 59), C not seen).

Jacquinia arborea is a member of the Caribbean complex of *J. armillaris* Jacquin, a group of three closely related taxa (Ståhl, 1992). *Jacquinia arborea* is distinctive among pale-flowered taxa in Mesoamerica due to the combination of broadly obovate to obovate leaves with revolute margins, and elongated, racemose inflorescences with 7 to 25(40) flowers.

Jacquinia arborea has the following floral dimensions: calyx lobes 2.2–3.2 mm long, 2.5–3.2 mm wide; corolla tube 4–5 mm long, the corolla lobes 2.8–4 mm long, 2.5–3.5 mm wide; the staminodes 1.8–3 mm long, 2–3 mm wide; stamens 2.7–3.8 mm long, filaments 1–1.8 mm long, anthers 1.7–2 mm long (Ståhl, 1992).

Distribution and habitat notes. In Mesoamerica *Jacquinia arborea* is only known from three localities. One of them is the Islas de la Bahía in Honduras. The second locality is Cozumel Island, in Quintana Roo State, Mexico (Ståhl, 1992). The third is the mainland at the archaeological site of Tulum, just across the narrow strait that separates Cozumel from mainland Quintana Roo (see collections below). Outside of Mesoamerica, this species is known from Jamaica, eastern Hispaniola, Puerto

Rico, the Lesser Antilles, Trinidad and Tobago, and Curazao and Bonaire (Ståhl, 1992).

In the area covered by this paper, *Jacquinia arborea* has always been collected growing in coastal dune shrubland, characterized by sclerophyllous shrubs and with an abundance of succulent herbs. *Jacquinia arborea* is usually a shrub or a small tree 3–6 m tall. It has been collected in flower in November–December, while mature fruits have been found in May–June.

Representative specimens studied. MEXICO. **Quintana Roo**: Municipio Cozumel, Isla de Cozumel, 35 km al S de San Miguel de Cozumel sobre el camino al faro y la punta Sur, 19 June 1985, *E. Cabrera & H. de Cabrera 8709* (MEXU, XAL); Municipio Solidaridad, Tulum Archeological Zone, 20°12′48″N, 87°25′45″W, 24 Nov. 1980, *J. I. Calzada et al. 7206* (CICY, XAL); Xel-Ha lagoon, 20°19′05″N, 87°21′25″W, 22 Apr. 1985, *J. S. Flores 10583* (CICY, XAL).

3. Jacquinia longifolia Standley, J. Wash. Acad. Sci. 14: 241. 1924. TYPE: El Salvador. San Vicente: vicinity of San Vicente, alt. 350–500 m, 2–11 Mar. 1922, *P. C. Standley 21159* (holotype, US; isotypes, F, G not seen, GH not seen, MO, NY not seen).

Jacquinia schippii Standley, Publ. Carnegie Inst. Wash. 461(4): 78. 1935. TYPE: Belize. Toledo: Jacinto Hills, in forest, alt. 270 m, 11 Dec. 1932, *W. A. Schipp 1233* (holotype, F; isotypes, A, BM, G, GH, K, MA, MICH, MO, NY, S, none of the isotypes seen).

Jacquinia longifolia is easily recognized by the spathulate, thinly textured leaves with a rounded to broadly acute apex; terminal spines are present or absent. The species seems to be extremely variable regarding size and disposition of the leaves, and the degree of development of the pubescence found in the lower third of the leaves, petioles, and inflorescences.

This species is similar to *Jacquinia paludicola* Standley. Both taxa are shade-loving and have leaves with flat margins that dry to a pale, dull green-brown hue. The flowers of the two species are similar in size and overall morphology and are similarly produced on short racemes or pseudo-umbels of 4 to 8 flowers, which are much shorter than the subtending leaves. The staminodes of *J. paludicola* are, however, more anther-like than in *J. longifolia* and are also inserted within the corolla mouth or barely protruding from it. Among Mesoamerican taxa of the genus with pale-colored flowers, *Jacquinia longifolia* may be closest phylogenetically to *J. arborea* because of its obovate, apically rounded or obtuse leaves and the overall structure of the flowers. *Jacquinia arborea*, however, features much longer inflorescences with many more flowers and is a plant of coastal habitats.

Jacquinia longifolia has the following floral dimensions: calyx lobes 2–2.5 mm long, 2–2.7 mm wide; corolla tube 2.5–3 mm long, the corolla lobes 2.5–3.2 mm long, 2–2.8 mm wide; staminodes 2–2.2 mm long, 1.5–2 mm wide at apex; stamens 3–3.7 mm long.

Distribution and habitat notes. *Jacquinia longifolia* occurs in Mexico (Quintana Roo), Belize, Guatemala (Petén), El Salvador, Honduras, and Nicaragua (Ståhl, 1989, 2001; Balick et al., 2000). The species has been collected at elevations ranging from −5 to 950 m, apparently always in humid vegetation associations such as tall evergreen forests. The single collection known from the Yucatán Peninsula was gathered in a low inundated forest. Flowering collections have been made in May through December.

Representative specimens studied. EL SALVADOR. **San Vicente**: vicinity of San Vicente, 7–14 Feb. 1947, *P. C. Standley & E. Padilla 3398* (GH, US), 2–11 Mar. 1922, *P. C. Standley 21743* (GH, US). MEXICO. **Quintana Roo**: Municipio Carrillo Puerto, Reserva de la Biósfera de Sian Ka'an, 20°50′N, 89°00′W, 28 June 1984, *R. Durán & I. Olmsted 1013* (CIQR, MO, XAL).

4. Jacquinia paludicola Standley, Field Mus. Nat. Hist., Bot. Ser. 11: 138. 1932. TYPE: Belize. Belize: Forest Home, alt. 60 m, 11 Sep. 1932, *W. A. Schipp 1028* (holotype, F not seen; isotypes, MO, NY, neither isotype seen).

Jacquinia paludicola is closely related to *J. longifolia*, as discussed above. Both tend to attain larger sizes than the other three pale-flowered *Jacquinia* species known from Mesoamerica, often being up to 20 m tall in *J. longifolia*. *Jacquinia paludicola* may be collected as an understory shrub or treelet up to 4 m tall, but some collections indicate heights up to 7 m. As in *J. longifolia*, the leaves are thin, but in *J. paludicola* the leaves are elliptic, acute, and long acuminate, and of larger sizes, to 14 cm long and 4.5 cm wide. The flowers have been described by collectors as yellow.

Distribution and habitat notes. *Jacquinia paludicola* is known only from the humid portions of the southern Yucatán Peninsula Biotic Province ranging into southern Belize and the Izabal Department of Guatemala (Ståhl, 1989, 2001; Balick et al., 2000). It has not yet been collected in the Mexican states of Quintana Roo and Campeche, but it is to be expected there. *Jacquinia paludicola* grows in tall evergreen forests and has been collected in flower in June through September; fruiting

material has been sampled in September to January.

Jacquinia paludicola has the following floral dimensions: calyx lobes ca. 3 mm long, 2.3–2.5 mm wide; corolla tube ca. 5 mm long, the corolla lobes ca. 2.5 mm long, ca. 2 mm wide; staminodes ca. 2 mm long, ca. 1.5 mm wide at apex; stamens 3.4–3.6 mm long, filaments 2 mm long, anthers 1.5 mm long.

Representative specimens studied. BELIZE. **Toledo**: Blue Creek, 16°20′N, 88°45′W, 12 June 1981, *C. Whitefoord 3217* (MEXU); Joe Taylor Creek, 30 Sep. 1952, *P. H. Gentle 7772* (GH, US). GUATEMALA. **Alta Verapaz**: bordering Río Chiyú, 3.5 km, 28 Sep. 1968, *E. Contreras 7753* (US); 6 km from Chahal, 16 Oct. 1968, *E. Contreras 7946* (US). **Petén**: Cerro Tzul, La Cumbre, *C. L. Lundell & E. Contreras 20176* (MEXU); Poptún, en camino a San Luis, km 117, 7 Jan. 1972, *R. Tun Ortiz 2160* (US), 7 Dec. 1970, *R. Tun Ortiz 1484* (US); Cadenas Road, km 142, 3 Nov. 1966, *E. Contreras 6515* (US); San Luis, Río Quebrada Seca, 11 July 1959, *C. L. Lundell 16364* (GH). **Izabal**: along Río Frio and tributaries, 18 Dec. 1941, *J. A. Steyermark 41537, 41546* (US).

5. Jacquinia sak-lol Carnevali, Hernández-Aguilar & Tapia-Muñoz, sp. nov. TYPE: Mexico. Quintana Roo: Municipio Othón P. Blanco, Ejido Caobas, Sabana del Jaguactal, un desvío de 9.5 km por carretera de terracería al oeste de la carretera hacia Tres Garantías, unos 21 km al sur de la carretera principal Xpujil–Chetumal, aprox. 18°18′00″N, 89°07′00″W, 31 May 2002, *F. Lara & R. Santos 6* (holotype, CICY; isotype, MO). Figure 1.

Species haec *J. paludicolae* similis sed foliis coriaceis brevioribus proportione latiore marginibus revolutis, floribus majoribus crassioribus, tubo proportione longiore abhorret; *J. longifoliae* similis sed foliis ellipticis acutis, marginibus revolutis, floribus majoribus differt.

Shrubs 0.8–1.5(–3) m tall; branchlets pubescent; terminal buds densely covered by scales (perulate); *leaves* 4.5–8.5 cm long, 1.7–3.3 cm wide, pseudo-verticillate on or near branch apex, and at the apex of next lower brachyblast, coriaceous, elliptic, acute to (rarely) obtuse or (teratologically) subtruncate, ending in a stiff mucro 1–1.5 mm long, basally decurrent, margin revolute, upper surface glabrous, punctate, underside lightly pubescent on the basal third, particularly over the mid-vein, venation brochidodromous; mid-vein channeled on the upper side, prominent on the underside; petiole ca. 1 mm long; *inflorescence* terminal or axillar, (1)2- to 4-flowered, ca. 9–12 mm long; peduncles ca. 5 mm long; pedicels 7.9–8.1 mm long, glabrous, the flowers 1–2 mm apart, thus inflorescence appearing pseudo-umbellate; *flowers* horizontally patent to sub-nutant, cream-white or pale yellow-white, ca. 1 cm long, glabrous; sepals 5 mm long, suborbicular or broadly elliptic, imbricate, margins ciliate, thin; corolla rotate, the tube 6–7 mm long, lobes ca. 4 mm long and wide; staminodes alternate to corolla lobes, ca. 2 mm long and wide, transversely oblong or broadly anchor-like in general outline, apex broadly obtuse to rounded; stamens inserted within the corolla tube, ca. 4 mm long, filaments 2 mm; anthers extrorse, 3 mm long, 1.6 mm wide; style 0.5 mm long, persistent, stigma capitate; *fruit* globose, ca. 1.5–2 cm diam., yellow at maturity, surface rugose; *seeds* brown, flat, 5.5 mm long, 4 mm wide.

Etymology. From the Mayan "sak," white, and "lol," flower, in allusion to the white (or nearly white) flowers of this species. The epithet choice *sak-lol* is allowed by Article 23.5 of the *Code* (Greuter et al., 2000) as a noun in apposition. The hyphen is deliberate and supported by Article 60.9, ex. 17.

This distinctive new species is vegetatively similar to some forms of the variable *Jacquinia macrocarpa* Cavanilles. A look at the flowers of both species, however, reveals immediately that such similarity is superficial. *Jacquinia macrocarpa* features bright orange, campanulate flowers, while *J. sak-lol* displays cream-white, tubular blooms.

The relationships of *Jacquinia sak-lol* seem to lie with *J. paludicola*. In both species the elliptic leaves are arranged in pseudo-whorls of 2 to 4 leaves along the stems but mostly close to the apex of the branches. The pseudo-whorls are separated by 5–10 cm on the branches (up to 15 cm long in *J. paludicola*). Both species feature a tubular, rotate corolla with the staminodes and the stamens inserted within the corolla tube. The staminodes are anther-like and conspicuously smaller than the corolla lobes. Both species also feature short-peduncled inflorescences with relatively few flowers.

Jacquinia sak-lol, however, is a shrub (as opposed to a tree) up to 2 m tall. The leaves are smaller and of a thicker texture. The margins of the leaf blade are revolute in *J. sak-lol* while they are flat in *J. paludicola*. The flowers are larger in *J. sak-lol* with a corolla tube of 6–7 mm long (vs. ca. 5 mm long) and the corolla lobes ca. 4 mm long and wide, as opposed to the 2.5 mm long, 2 mm wide corolla lobes of *J. paludicola*.

Distribution and habitat notes. *Jacquinia sak-lol* occurs in shady spots inside low-inundated forests (locally known as "tintales" because of the dominance of *Haematoxylum campechianum* L.) or in a mosaic of tall evergreen forests and tintales.

Figure 1. *Jacquinia sak-lol* Carnevali, Hernández-Aguilar & Tapia-Muñoz. —A. Flowering habit. —B. Flower, lateral view. —C. Flower tube split lengthwise, showing staminodes, stamens, and ovary; because of some distortion that occurred in the process of cutting and laying out the tube, the staminodes are not totally alternate with the corolla lobes. Drawn by Rossana Marrufo based on *G. Carnevali, F. May-Pat & M. Gómez 5063* (CICY).

Elevations range from 50 to 250 m. It is a sparsely branched shrub or small tree that appears to grow at low population densities. The species has been collected in flower only in May, while fruiting specimens have been gathered in August and January.

Paratypes. MEXICO. **Quintana Roo**: Municipio Othón P. Blanco, 5 km al N de La Unión, alrededores del rancho Paso del Danto, 17°57′30″N, 88°53′00″W, aprox. 150 msnm, 27 Jan. 1999, *F. May et al. 1386* (CICY), 2 Aug. 1992, *J. Granados 58* (CICY); Ejido Caobas, 26 km al S de la carretera Xpujil a Chetumal, por la vía a Tres Garantías, sobre la brecha ca. 3 km al W de la carretera, ca. 18°13′30″N, 89°04′20″W, 27 May 1998, *G. Carnevali et al. 5063* (CICY).

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Acer yangbiense (Aceraceae), a New Species from Yunnan, China

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ABSTRACT. *Acer yangbiense* Y. S. Chen & Q. E. Yang, a new species from Yangbi County, Yunnan Province, is described and illustrated. This species is similar to *Acer leipoense* Fang & Soong from western Sichuan in having a pale gray abaxial surface of the leaves, a much longer glabrous infructescence and fruiting pedicels, and convex nutlets, but differs by its larger 5-lobed leaves with a cordate base, abaxially densely pubescent veins and veinlets, and pubescent young branchlets and petioles.

Key words: *Acer*, Aceraceae, China, Yunnan.

In the course of checking specimens of the Chinese Aceraceae in the herbarium of Sichuan University (SZ) in 2001, a specimen from Yangbi County, Yunnan, *R. C. Ching 22525*, caught our attention. Fang Wen-Pei identified it as *Acer kungshanense* Fang on the *determinavit* slip in 1959, although this species was not formally published by him and C. Y. Chang until 1966 (Fang, 1966). At first glance this specimen is somewhat similar to *A. kungshanense* in having leaves abaxially densely hairy, but differs in having 5-lobed leaves, a pale gray abaxial surface of the leaves, a glabrous infructescence, and convex nutlets. In contrast, *A. kungshanense* has 3-lobed leaves, a yellow-brown abaxial surface of the leaves, a pubescent infructescence, and ovoid-globose nutlets. This specimen is more similar to *A. leipoense* in having a pale gray abaxial surface of the leaves, a glabrous infructescence, and convex nutlets, but differs by its 5-lobed leaves, which are abaxially densely hairy along the veins and veinlets, and thus may represent an undescribed species. Unfortunately, this specimen is in poor condition, with the infructescence being incomplete, so in April 2002 the first author made an expedition to Yangbi County in northwest Yunnan to collect more specimens. A large tree bearing young fruits was found. Although flowering specimens were unavailable, some fruits that were still bearing perianths and anthers were gathered. This confirmed to the authors that the plant really is a new species.

Acer yangbiense Y. S. Chen & Q. E. Yang, sp. nov. TYPE: China. Yunnan: Yangbi County, Malutang, forests, alt. 2400 m, 24 Apr. 2002, *Y. S. Chen 2010* (holotype, PE; isotypes, MO, PE). Figures 1, 2.

Species *A. leipoensi* affinis, sed differt foliis majoribus, 10–20 cm longis, 11–25 cm latis, 5-lobatis, basi cordatis, nervis primariis 5, nervis et venis subtus densissime pubescentibus.

Deciduous tree, up to 20 m tall; trunk up to 20 cm diam.; branchlets of the present year greenish, pubescent; branchlets of the previous year brown-green, pale gray pubescent; those more than two years old light brown or dark brown, glabrescent, with noticeable brown-yellow lenticels; winter buds ovoid, dark brown, imbricate scales about 9 pairs, tomentose outside, dropping off soon after the flowers or leaves have matured. Leaves chartaceous, 10–20 × 11–25 cm, usually broader than long, shallowly 5-lobed, base cordate, deep green above, glabrous, pale green beneath, abaxially very densely pubescent along veins and veinlets; basal lobes usually smaller, apex acuminate, or accidentally absent; middle and lateral lobes triangular-ovate, apex acuminate, entire or remotely toothed with a few sinuous teeth; primary veins 5, impressed on the upper surface, conspicuously prominent below; central lobe with 7 to 9 pairs of parallel lateral veins; petioles 4–17 cm long, pale gray pubescent. Racemes glabrous, pendulous, arising from leafless lateral buds of 2- or 3-year-old branchlets. Flowers hermaphroditic, yellow-green; sepals 5, ovate-oblong, ca. 4.5 × 4 mm, yellow-green, glabrous; petals 5, ovate, yellow-green, base narrow. Intrastaminal disk glabrous; stamens 8; filaments ca. 2–3 mm long; anthers ovoid, ca. 1 mm long; styles 2, base

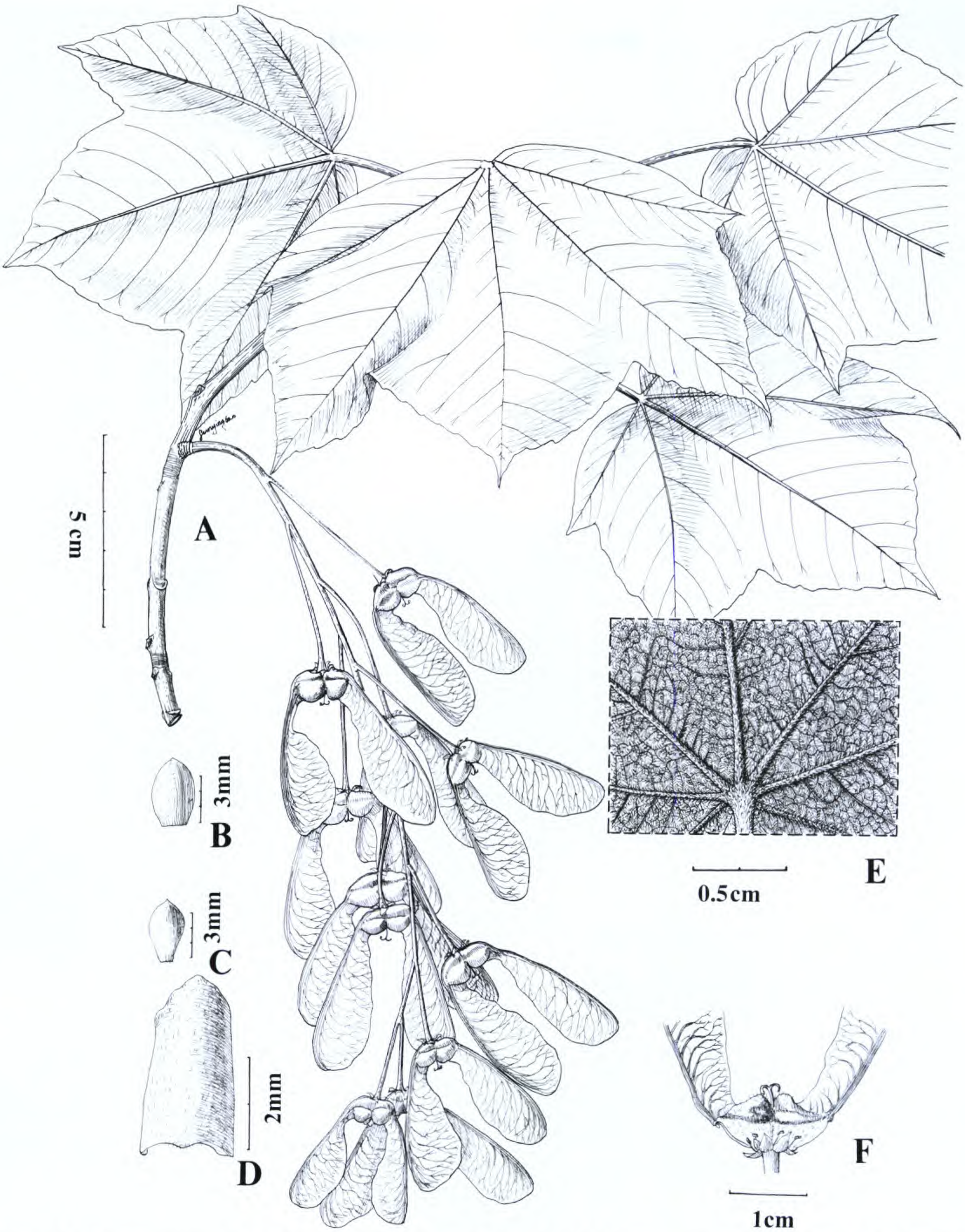

Figure 1. *Acer yangbiense* Y. S. Chen & Q. E. Yang. —A. Branch with infructescence. —B. Sepal. —C. Petal. —D. Bud scale. —E. Pubescence on the abaxial surface of leaves. —F. Details of young fruit with persistent stamens. Drawn from *Y. S. Chen 2010* (PE).

united, the free portion curved downward; stigmas 2, simple. Infructescence pendulous, ca. 9–32 × 7 cm; fruits 9 to 17 per raceme, red-green when young, brown-yellow when mature; wings together with nutlets 4.7–5.5 × 1.4–1.7 cm, strongly veined, spreading at acute or nearly right angles; fruiting pedicels 2.7–3.4 cm long, glabrous; nutlets ca. 7 mm diam., middle convex, globose, villous.

Figure 2. *Acer yangbiense*.—Above. Fruiting branch. —Below. Pubescence on the abaxial leaf surface. Photographs by Yousheng Chen.

Distribution and habitat. This species seems restricted in distribution. So far it is known only from its type locality, a valley in the western slope of Mt. Cangshan, Yangbi, northwestern Yunnan. Just above this area grows a large forest of *Rhododendron delavayi* Franchet. Its population is small, consisting of no more than 10 trees sparsely scattered near a small village. It is therefore to be considered a rare and endangered species. According the IUCN red list categories and criteria, Ver-

sion 3.1 (IUCN, 2001), it should be categorized as a critically endangered species.

Taxonomic remarks. According to Ogata (1965), *Acer* sect. *Lithocarpa* Pax is characterized by having dioecious flowers, racemose inflorescences from leafless lateral buds, and buds with 8 to 12 pairs of imbricate scales. This section includes a few species with ranges from the Himalayas to Japan. Among them, *A. leipoense* subsp. *leipoense* is found only in Leipo County in Sichuan Province, and *A. leipoense* subsp. *leucotrichum* Fang only in Baoxing and Tianquan Counties in Sichuan Province. The first author made an expedition to find these two subspecies in western Sichuan in 2001, but failed to find specimens of either one. We have also examined specimens of Aceraceae in the major herbaria in China and found just two specimens each of *A. leipoense* subsp. *leipoense* and *A. leipoense* subsp. *leucotrichum*. To our knowledge, the two subspecies of *A. leipoense* are also critically endangered. The two subspecies of *A. leipoense* and *A. yangbiense* can be distinguished from the remaining species in section *Lithocarpa* Pax by having a pale gray abaxial surface of the leaves, convex nutlets, and a much longer infructescence and fruiting pedicels.

Acer yangbiense is similar to *A. leipoense* subsp. *leipoense* in having a pale gray abaxial surface of the leaves, a long glabrous infructescence and fruiting pedicels, and convex nutlets, but differs by its larger 5-lobed leaves very densely pubescent abaxially along veins and veinlets, and pubescent young branchlets and petioles. *Acer leipoense* subsp. *leucotrichum* is different from the new species by its much smaller 3-lobed leaves (9–11 × 11–12 cm) and nutlets (3.5–4.3 × 0.8–1.3 cm), and shorter fruiting pedicels (1.8–3 cm). The leaf bases of both subspecies of *A. leipoense* are rounded, while those of *A. yangbiense* are cordate. The leaves of *A. leipoense* subsp. *leucotrichum* are abaxially only sparsely pubescent and the hairs cannot be felt with fingers, while the leaves of *Acer yangbiense* are abaxially so densely pubescent that the hairs can easily be felt. Thus, *A. yangbiense* can be distinguished from *A. leipoense* subsp. *leucotrichum* by the pubescence character.

The circumscription of *Acer* sect. *Lithocarpa* made by de Jong (1994) is almost the same as that made by Ogata (1965) except that de Jong treated *A. macrophyllum* Pursh in this section as a monospecific series, series *Macrophylla* Pojárkova ex Momotani, while Ogata treated it as an independent section, section *Macrophylla* (Pojárkova) Ogata. *Acer yangbiense* is a member of *Acer* sect. *Lithocarpa* ser. *Lithocarpa* by having racemes arising from leafless lateral buds and about nine pairs of imbricate scales on the buds.

Paratype. CHINA. **Yunnan:** Yangbi, Ma-lu-tang, 3 May 1929, *R. C. Ching 22525* (SZ).

KEY TO *A. YANGBIENSE*, *A. LEIPOENSE*, AND *A. KUNGSHANENSE*

1a. Abaxial surface of leaves yellow-brown; infructescence 7–9 cm long, glabrous; fruits 4 to 7 per raceme; nutlets globose . . . . . *Acer kungshanense*
1b. Abaxial surface of the leaves pale gray; infructescence 10–32 cm long, ± pubescent; fruits 9 to 17 per raceme; nutlets convex.
  2a. Leaves 9–11 × 11–12 cm, sparsely pubescent abaxially along veins and veinlets (hairs cannot be felt with fingers); leaf blade 3-lobed, base rounded; nutlets 3.5–4.3 × 0.8–1.3 cm . . . . . *Acer leipoense*
  2b. Leaves 10–20 × 11–25 cm, densely pubescent (hairs can be easily felt with fingers); leaf blade 5-lobed, base cordate; nutlets 4.7–5.5 × 1.4–1.7 cm . . . . . *Acer yangbiense*

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Sterculiaceae (Byttnerieae) Nuevas de Perú

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RESUMEN. Se describen e ilustran dos Sterculiaceae nuevas del norte de Perú: *Ayenia peregrina* y *Byttneria sagasteguii*. Se comparan ambas novedades con las especies afines. *Ayenia peregrina* corresponde a la sección *Leiayenia*. Se llama la atención sobre el hallazgo de un representante de esta sección en Sudamérica, ya que el área conocida abarcaba el centro sur de los Estados Unidos de América, Centroamérica y las Antillas Mayores. *Byttneria sagastegui* pertenece a la sección *Incasica*.

ABSTRACT. *Ayenia peregrina* and *Byttneria sagasteguii*, two new species from the north of Peru, are described, illustrated, and compared to related species. The remarkable finding of *A. peregrina* is discussed because it belongs to *Ayenia* sect. *Leiayenia*, known up to now from the south-central U.S.A., Central America, and the Greater Antilles. *Byttneria sagasteguii* belongs to section *Incasica*.

Key words: *Ayenia*, *Byttneria*, Perú, Sterculiaceae.

Ayenia peregrina Cristóbal, sp. nov. TIPO: Perú. Amazonas: along road Pedro Ruiz–Chachapoyas, in dry scrub, with cacti and bromeliads, 1300–1900 m, 11 Mar. 1998, *H. van der Werff, B. Gray, R. Vásquez & R. Rojas 14669* (holótipo, MO; isótipos, CTES, F, MO, NY). Figura 1.

Suffrutex ca. 1 m altus pilis stellatis dense tectus. Folia ovata-lanceolata dentata discolora subtus cinerea. Cimae axillares breves triflorae. Petala longissime unguiculata cucullo subtrapeziforme apice integro dentibus duobus intus instructa; lamina petalorum nulla; androgynophorus nullus; tubus staminalis urceolatus antheribus triloculatibus staminodiis cucullatis. Fructus ca. 4 mm latus aculeolis brevissimis et pilis stellatis tectus.

Subarbusto de 0.90–1 m alt., tallo leñoso con corteza grisácea, delgada, finamente estriada con lenticelas redondeadas, ramas con una alternancia de porciones cicatricosas, desnudas y entrenudos muy cortos, con porciones con entrenudos largos de 1–1.5 cm long., los extremos floríferos y hojosos amarillo-tomentosos, cubiertos de una gruesa capa de pelos estrellados, intrincados, con numerosos radios, sésiles o largamente estipitados, estípite de ca. 0.5 mm long., castaño, el extremo frágil. Estípulas linear-subuladas, caedizas, 1.5–3 mm long., tomentosas. Pecíolo terete, 1–1.5 cm long., con el mismo indumento del tallo. Lámina discolora, ovado-lanceolada, base cordada, ápice agudo, 3–5 × 1.5–2.8 cm, margen dentado, en las hojas más viejas el ápice de los dientes glabro, papiloso y oscuro, epifilo gris-verdoso, tomentoso, hipofilo cinéreo, indumento más denso que en el epifilo y con pelos más largos, sobre las venas pelos estipitados, venas basales 7–9, desde la vena media 3–4 pares de venas laterales más o menos rectas y sobresalientes hasta el margen. Alabastros globosos. Flores reunidas en cimas axilares abreviadas, 3-floras, pedúnculo y pedicelos 3–7 mm long., ambos más largos en el fruto, bractéolas 1–1.5 mm long., subuladas, tomentosas, agrupadas en el extremo del pedúnculo. Sépalos 2.7–3 × 1.5–2 mm, soldados cerca de la base, ovales, abruptamente afinados en el 1/3 apical, cara externa tomentosa, pelos estrellados sésiles y brevemente estipitados, cara interna con la vena media muy sobresaliente, pelos glandulares breves dispersos. Pétalos rojizos, glabros, opuestos a los estambres, largamente unguiculados, lámina nula, porción basal de la uña filiforme de 5 mm long., capucha subtrapezoidal, adosada al borde del tubo estaminal, ca. 1.5 × 2 mm, lóbulos con el margen distal eroso, cara externa con la mitad apical ampollada, extremo proximal redondeado con un diminuto mucrón oscuro en el centro, y con dos dientes incurvados que abrazan al filamento estaminal, cara interna con una leve concavidad que aloja a la antera. Androginóforo nulo. Tubo estaminal urceolado, 1 mm alt., glabro, anteras tritecas en el extremo de una corta porción libre de filamento, estaminodios cuculados, margen externo con un pequeño apículo medio. Ovario más o menos globoso, cubierto de mamilas, estilo exerto, estigma redondeado. Cápsula globosa, ca. 4 mm diám., a la madurez disgregada en 5 cocos uniseminados dehiscentes a lo largo de la sutura y de parte de la vena media dorsal, mitades curvas separadas entre sí, cara externa cubierta de aculeolos cilíndricos, hasta 1/2 mm long., oscuros,

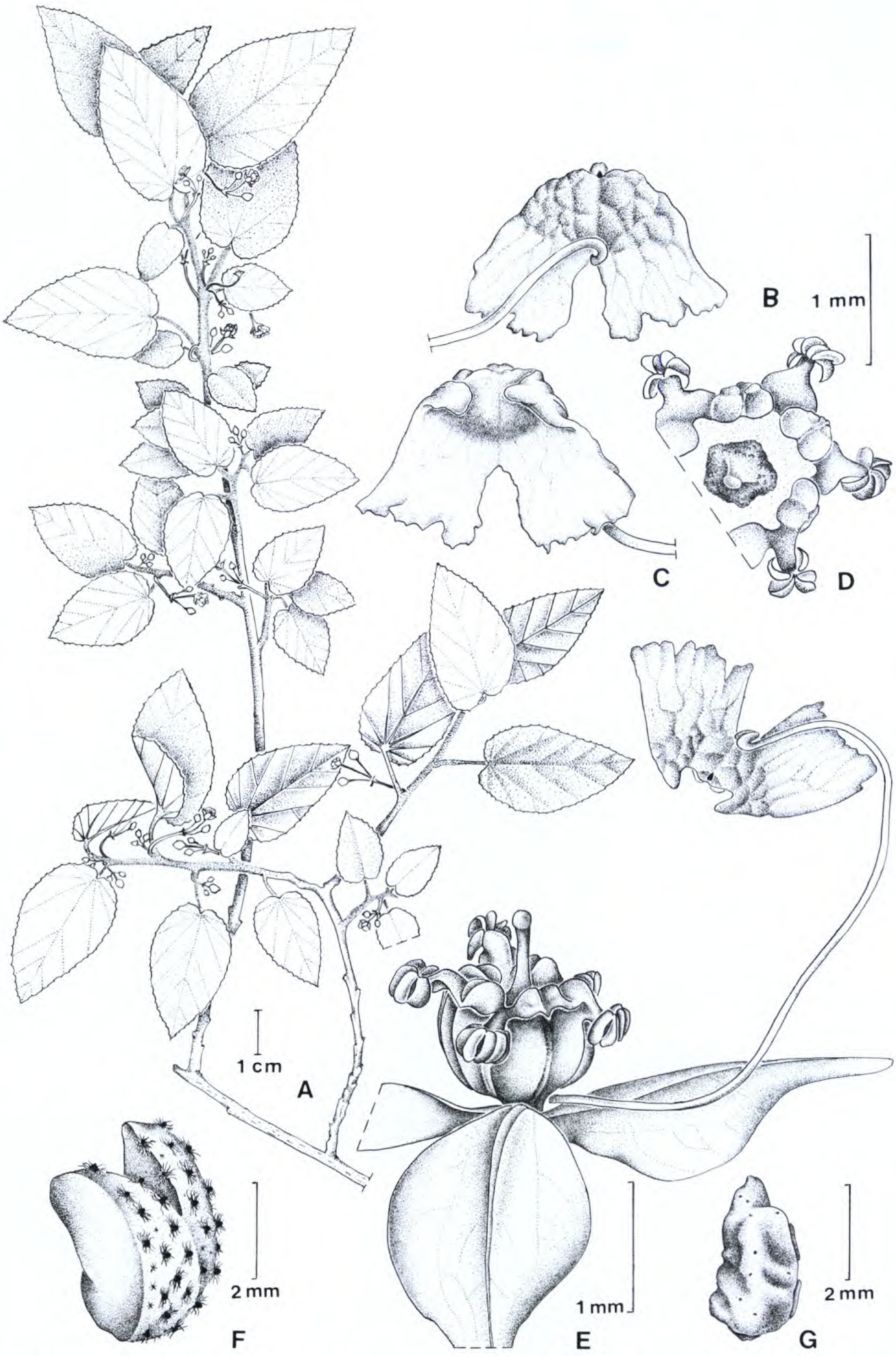

Figura 1. *Ayenia peregrina* Cristóbal. —A. Rama. —B. Capucha del pétalo y parte de la uña, cara externa. —C. Capucha del pétalo, cara interna. —D. Porción del tubo estaminal, visto desde arriba y gineceo. —E. Flor: parte del cáliz sin el indumento, 1 pétalo separado del tubo estaminal visto de frente, tubo estaminal y gineceo. —F. Coco dehiscente. —G. Semilla, vista lateral. A, F, G: dibujado del tipo *van der Werff et al. 14669* (CTES). B–E: *Vásquez et al. 25942* (CTES).

con pelos estrellados, también pelos estrellados entre los aculeolos, cara interna lustrosa, diminutos pelos glandulares rojizos dispersos y escasos pelos largos, simples. Semillas angostamente ovoides, ápice cónico, 2.5 × 1.5 mm, castañas o negras, caras laterales rugosas más o menos planas, dorso convexo también rugoso, pequeñas verrugas dispersas en toda la superficie.

Ayenia peregrina pertenece a la sección *Leiayenia* Grisebach caracterizada por los pétalos sin lámina, constituidos sólo por la capucha con dos dientes incurvados en el extremo proximal, que abrazan la porción libre del filamento estaminal. Como se señaló en trabajos anteriores (Cristóbal, 1960, 1961, 1962), las especies de esta sección difieren notablemente entre sí en el aspecto vegetativo y en diversos caracteres florales, en contraposición a las otras secciones del género donde con frecuencia las diferencias interespecíficas son muy finas. Al comparar las flores de *A. peregrina* con las de las especies afines, vemos que, curiosamente, las más semejantes son las de *A. microphylla* A. Gray, especie que ocupa el extremo norte del área de la sección. Se diferencian sin embargo porque en *A. peregrina* la capucha de los pétalos es ampollada, de mayor tamaño y con los lóbulos erosos. En *A. microphylla* la capucha posee en el margen proximal una superficie plana prolongada en un notable apículo retrorso hacia la cara externa. Otra diferencia es el androginóforo, nulo en *A. peregrina* y aunque breve, presente en *A. microphylla*. Finalmente, el tamaño de la hojas y el indumento, que hace que las de *A. peregrina* sean discoloras, las diferencian a simple vista.

Con este hallazgo ascienden a 12 las especies de la sección *Leiayenia*. En el hemisferio norte *A. microphylla* vive en el centro-sur de los Estados Unidos de América y NE de México, cinco especies son exclusivas de México y cinco viven en las Antillas Mayores. El hallazgo de un miembro de esta sección en los Andes del N de Perú, es un ejemplo particularmente interesante para el estudioso del origen y de las relaciones de la flora peruana. Ya Weberbauer (1945: 657), en su capítulo sobre la "Génesis de la Flora Peruana", llama la atención sobre la disyunción del área de especies xerofíticas comunes entre el sur de los Estados Unidos y México y territorios interandinos de Perú.

La sección *Leayenia* era la única del género cuya área no abarcaba Sudamérica, ya que *A. magna* L., que se extiende desde el Caribe hasta el NW de Paraguay, representa a la sección *Cybiostigma* (Turczaninow) Grisebach. La sección *Ayenia* está difundida en ambos hemisferios.

Parátipo. PERÚ. **Amazonas:** Bagua Distrito, Pongo de Rentema. Bosque del valle seco del Marañón, 05º30'S, 78º30'W, 400 m, 4 Feb.1999, *R. Vásquez, C. Díaz, F. Salvador et al. 25942* (CTES, F, MO, NY).

Byttneria sagasteguii Cristóbal, sp. nov. TIPO: Perú. Cajamarca: Chota, Tucupampa (Llama-Huambos), ladera, 2500 m s.m., sufrútice con flores vinosas, 17 Mar. 1997, *A. Sagástegui A., S. Leiva G. & V. Quipuscoa 15947* (holótipo, F; isótipos, CTES, HUT). Figura 2.

Frutex caulibus pentagonis in costis parvis aculeis rectis 0.5–2 mm longis. Lamina ovata-lanceolata vel late ovata supra pilis setiformibus antrorsis subtus tomentosis pilis simplicibus. Inflorescentia nuda ramosa 3–5 cm longa. Unguis petalorum membranaceus alis rotundis; lamina leviter pubescens in dimidio superiore incrassata ad apicem acuta; antherae biloculares; staminodia membranacea in latere externo prominentia acuta.

Arbusto de ca. 2 m alt. (Sagástegui A., comunicación personal), aparentemente tortuoso, setuloso, pelos simples, largos, gruesos distribuidos en todos sus órganos. Tallo, cerca de los extremos floríferos, 8–13 mm diám., macizo o fistuloso en los entrenudos, con 5 caras planas demarcadas por costillas colenquimatosas sobresalientes, amarillentas, con pequeños aguijones rectos, frágiles, densamente dispuestos, no alineados entre sí, de 0.5–2 mm long., punzantes y terminados en 1 pelo, cerca del ápice de las ramas setas dispersas, sobre las costillas y escasas en las caras. Estípulas fugaces, finamente subuladas, ca. 4 mm long., cara interna glabra, cara externa pilosa. Pecíolo 12–25 mm long., inerme, con los mismos pelos del tallo. Lámina del extremo de las ramas ovado-lanceolada, base redondeada o subcordada, ápice agudo, en ramas más viejas anchamente ovada, base cordada, ápice agudo, margen serrado, entero cerca de la base, epifilo uniformemente cubierto de setas antrorsas, que dejan ver la superficie de la epidermis, hipofilo densamente cubierto de pelos setiformes especialmente sobre las venas, más densamente dispuestas y desordenadas, venación poco notable en el epifilo y sobresaliente en el hipofilo, desde la base parten 2–3 pares de venas laterales y desde la vena media 5–6 pares de venas enfrentadas más o menos rectas y paralelas hasta el margen, nectario ubicado en la base de la vena media, destacándose solamente por ser una porción, más oscura, algo más ancha y con escaso indumento. Flores reunidas en inflorescencias tirsoideas desnudas, axilares y terminales de 3–5 cm long., el eje con cerca 5 nudos origina en cada uno de ellos 3–5 cimas umbeliformes plurifloras de 1.5–2 cm long., en la base de cada cima un verticilo de bractéolas rojizas, membranáceas, soldadas en la base, laci-

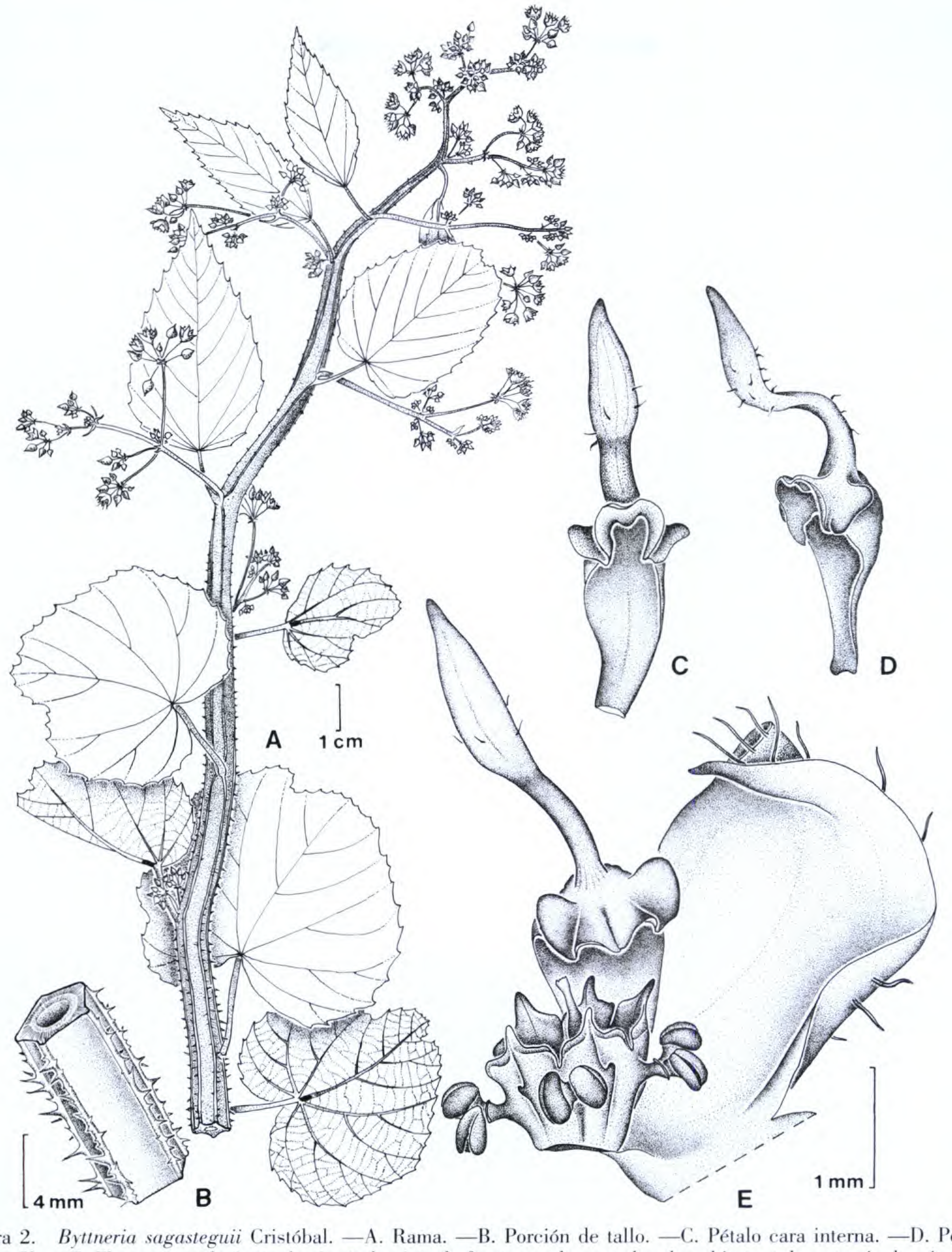

Figura 2. *Byttneria sagasteguii* Cristóbal. —A. Rama. —B. Porción de tallo. —C. Pétalo cara interna. —D. Pétalo 3/4 perfil. —E. Flor mostrando 1 sépalo, 1 pétalo visto de frente con la capucha algo abierta, tubo estaminal y gineceo. Dibujado del tipo *Sagástegui A. et al. 15947* (CTES).

niadas, pedicelo 4–5 mm long. Sépalos morados, 4–5 × 2.3–2.5 mm, soldados en el tercio basal, lóbulos ovados, cara interna con pelos glandulares diminutos dispersos, cara externa con pelos simples, largos, dispersos. Pétalos 3–5 mm long., divididos en dos porciones de aproximadamente el mismo largo: la capucha amarillenta, glabra, membranácea, con las alas muy pequeñas, redondeadas, curvadas levemente hacia arriba, y la lámina con escasos pelos cortos dispersos, la mitad basal plana, membranácea, amarillenta, y la mitad apical, morada, ancha, carnosa, algo aplastada, aguda. Tubo estaminal campanulado, glabro, membranáceo, 1.3–1.5 mm long., amarillento excepto una mancha morada en la cara externa de los estaminodios, estambres con una porción muy breve de

filamento, anteras algo divergentes, ditecas; estaminodios membranáceos, margen con un apículo central y un pequeño lóbulo redondeado y algo recurvado a cada lado, cara externa con una prominencia aguda sobre la línea media. Gineceo ca. 1.5 mm long., sobresaliendo levemente del tubo estaminal, ovario papiloso, lóbulos del estigma del mismo ancho que el estilo, redondeados. Fruto no visto.

Byttneria sagasteguii pertenece a la sección *Incasica* Cristóbal (Cristóbal, 1976), ya que los pétalos se apoyan en el borde del tubo estaminal, los estaminodios son membranáceos con una prominencia aguda en la cara externa y los tallos tienen costillas sobresalientes con aguijones.

Dentro de la sección, esta nueva especie se diferencia por la siguiente combinación de caracteres: tallos con pequeños y numerosos aguijones rectos no alineados entre sí, hojas densamente cubiertas de largos pelos setiformes, lámina de los pétalos con la mitad distal abultada, carnosa, morada y con escasos pelos dispersos e inflorescencia amplia, tirsoidea, desnuda, tanto axilar como terminal. Si nos esforzamos en encontrar alguna especie afín se puede comparar con *B. flexuosa* Killip, especie de Ecuador, pero los caracteres arriba mencionados las separan fácilmente.

En la revisión de *Byttneria* Loefling (Cristóbal, 1976) se incluyeron 11 especies en la sección *Incasica*. Posteriormente Dorr (1997, 1999), adiciona una especie nueva de Ecuador: *B. jaramilloana* Dorr y pasa a la sinonimia de *B. parviflora* Bentham a *B. glabrescens* Bentham.

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Eleutherococcus humillimus, a New Combination in Chinese Araliaceae

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ABSTRACT. A new combination, *Eleutherococcus humillimus* (Y. S. Lian & X. L. Chen) Y. F. Deng, is made.

Key words: *Acanthopanax*, Araliaceae, China, *Eleutherococcus*.

Eleutherococcus Maximowicz (1859) is the correct name for the genus previously widely referred to as *Acanthopanax* (Decaisne & Planchon) Witte (1861). Nomenclatural problems involving these genera have been discussed by several authors over the years (Hu, 1980; Ohashi, 1987; Hsu & Pan, 1993; Zhu et al., 1995). *Eleutherococcus* has about 25 species distributed mainly in northeastern Asia, including China, Korea, and Japan, with some members extending to southwestern Asia (Kim & Sun, 2000).

Acanthopanax was recognized at the subgeneric rank under *Panax* L. by Decaisne and Planchon (1854), and was later raised by Witte (1861) to generic rank. Harms (1897: 49) combined both under one genus and adopted the name *Acanthopanax*, which has been widely used since by many botanists (Harms, 1918; Li, 1942; Hoo & Tseng, 1978; Philipson, 1979; Shang, 1985a, 1985b). However, the name *Acanthopanax* does not have priority under the current ICBN (Greuter et al., 2000), and several recent authors (e.g., Hu, 1980; Stone, 1980; Ohashi, 1987; Hsu & Pan, 1993; Zhu et al., 1995) have accordingly transferred taxa from *Acanthopanax* to *Eleutherococcus*.

In 1918 Harms classified the genus into seven sections, namely, sect. *Eleutherococcus*, sect. *Cephalopanax*, sect. *Euacanthopanax*, sect. *Zanthoxylopanax*, sect. *Evodiopanax*, sect. *Sciadophylloides*, and sect. *Kalopanax*. This system has been accepted by many authors (Hoo & Tseng, 1978; Shang, 1985a, 1985b; Ohashi, 1987), but section *Kalopanax*, typified by *K. pictus* (Thunberg) Nakai, is generally treated as a distinct genus. Several years later, Nakai (1924) elevated section *Evodiopanax* to generic rank, then Shang et al. (2000) synonymized it with *Gamblea* C. B. Clarke and made four new combinations. Shang and Huang (1993) raised section *Sciadophylloides* to generic rank as *Chengiopanax* C. B. Shang & J. Y. Huang with two species, *C. fargesii* (Franchet) C. B. Shang & J. Y. Huang and *C. sciadophylloides* (Franchet & Savatier) C. B. Shang & J. Y. Huang. Recognition of the unarmed genera *Gamblea* and *Chengiopanax* as distinct from *Eleutherococcus*, which has spines or prickles, was recently confirmed using ITS sequence data (Wen et al., 2001).

Acanthopanax humillimus Y. S. Lian & X. L. Chen was described by Lian and Chen (1994) based on collections from Gansu Province, China, but the necessary combination in *Eleutherococcus* is made here.

Eleutherococcus humillimus (Y. S. Lian & X. L. Chen) Y. F. Deng, comb. nov. Basionym: *Acanthopanax humillimus* Y. S. Lian & X. L. Chen, Acta Bot. Boreal.-Occid. Sin. 14(6): 76. 1994. TYPE: China. Gansu: Lintan Xian, "Lianhua mountain, in locis udis regionis in sylvis," 2700 m, 9 July 1994, *Y. S. Lian et al. 94065* (holotype, NWTC).

Distribution. A rare species endemic to southern Gansu and northern Sichuan Provinces of China, in alpine habitats at high elevations (2700–3000 m).

Eleutherococcus humillimus most closely resembles *E. giraldii* (Harms) Nakai but differs in being a subshrub, only 5–15 cm tall (vs. 1–3 m), with 3 or 4 (rarely 5) ovaries and styles (vs. 5 ovaries and styles), the latter connate for ca. 1/5 their length (rather than 1/4–1/2). *Eleutherococcus humillimus* occurs at high elevations and may be an alpine vicariant of *E. giraldii*.

Additional specimens examined. CHINA. **Sichuan:** Hongyuan Xian, Shuajingsi, Yakou, alt. 3450 m, in ravine, 8 Oct. 1957, *Li Xing 72410* (IBSC, SZ); Hongyuan Xian, Shuajingsi, Yakou, alt. 3400 m, 9 Oct. 1957, *Li Xing 72444* (IBSC, SZ); Nanping Xian, Jiuzhaigou, 3200 m, in *Picea* forest, 25 Sep. 1986, *Wu Zhengyi et al. 811* (KUN); Nanping xian, Jiuzhaigou, Changhai, 2800 m, in *Picea* forest, 26 Sep. 1986, *Wu Zhengyi et al. 982* (KUN); Nanping Xian, Jiuzhaigou, in forest, 25 Sep. 1986, *Wu Zhengyi et al. 1110* (KUN); Zoigê (Ruoergai) Xian, Baxi gongshe,

Yangyugou, in *Picea* forest, alt. 3100 m, 28 June 1975, *Chengdu Biological Institute 10063* (IBSC). **Gansu:** Dangchang xian, Daheba, in subalpine shrubby, alt. 3000 m, 24 Sep. 1979, *Lian Yongshan 790922* (NWTC); Tewo xian, Lazikou Linchang, in the forest, on the rock, alt. 3000 m, 24 July 1980, *Lian Yongshan et al. 800222* (NWTC).

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Transfer of Madagascan *Glochidion* to *Phyllanthus* (Euphorbiaceae s.l. or Phyllanthaceae)

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ABSTRACT. Seven endemic Madagascan species previously assigned to the genus *Glochidion* J. R. & G. Forster by Leandri are re-examined morphologically and found to belong to *Phyllanthus* L. (Euphorbiaceae s.l. or Phyllanthaceae). As a consequence, the following five new combinations are made: *Phyllanthus ankaratrae* (Leandri) Petra Hoffmann & McPherson, *P. humbertii* (Leandri) Petra Hoffmann & McPherson, *P. lichenisilvae* (Leandri) Petra Hoffmann & McPherson, *P. marojejiensis* (Leandri) Petra Hoffmann & McPherson, and *P. perrieri* (Leandri) Petra Hoffmann & McPherson.

Key words: Euphorbiaceae, *Glochidion*, Madagascar, *Phyllanthus*.

The Euphorbiaceae–Phyllanthoideae volume of the *Flore de Madagascar et des Comores* (Leandri, 1958) treated seven species in the genus *Glochidion* J. R. & G. Forster, distinguishing them from *Phyllanthus* L. by their reduced, or small and entire styles. Leandri described the first of these seven species, *G. perrieri*, in 1934 and placed it in section *Heteroglochidion* Müller Argoviensis. This section is typified by the New Caledonian species *G. baladensis* (Baillon) Müller Argoviensis, which has long, free styles and is today again considered a species of *Phyllanthus* (Schmid & McPherson, 1991). In 1937, Leandri described *G. lichenisilvae* and transferred two of his own *Phyllanthus* species, *P. oreichtitus* and *P. sambiranensis*, to *Glochidion*. Three further species, *G. ankaratrae*, *G. humbertii*, and *G. marojejiense*, were described in 1957 (Leandri, 1957).

Glochidion and *Phyllanthus* are both members of subtribe Flueggeinae (tribe Phyllantheae), the largest and most difficult group in subfamily Phyllanthoideae, or family Phyllanthaceae sensu APG (e.g., Savolainen et al., 2000, Chase et al., 2002). The last complete treatment of this group at species level was published by Müller Argoviensis (1866), who combined *Glochidion* with *Phyllanthus*. Bentham and Hooker (1880) followed Müller in this but most later authors (e.g., Hooker, 1887, Pax & Hoffmann, 1931, Webster, 1994, Radcliffe-Smith, 2001) have regarded *Glochidion* as a separate genus.

Phyllanthus is an extremely diverse pantropical group of ca. 800 species that may not be monophyletic (Webster, 1994, Wurdack et al., in prep.). Molecular analyses are under way as a collaboration between the University of Vienna and the Royal Botanic Gardens, Kew, to shed light on the position of *Glochidion*, which Webster (1994: 46) considered to "represent a specialized offshoot from ancestral taxa within *Phyllanthus*." *Glochidion* is generally recognized as being restricted to Asia and Australasia (Webster, 1994), sometimes with the exception of the Madagascan species (Radcliffe-Smith, 2001).

Webster (1994) and Radcliffe-Smith (2001) distinguished the two genera mainly on the basis of the following characters: floral disc (usually present in *Phyllanthus*, totally absent in *Glochidion*) and seed morphology (dry and not ventrally invaginated in *Phyllanthus*, usually fleshy (with sarcotesta) and ventrally invaginated in *Glochidion*). Stuppy (1996) confirmed the importance of seed characters in separating the two taxa.

Examination of the material in Paris (including all types) showed that all seven Madagascan species must be referred to *Phyllanthus* on the basis of both disc and (where available) seed characters. Brunel (1987) was the first to come to this conclusion when examining *Glochidion oreichtitum* and *G. sambiranense*. He found the pollen of these two species to be tricolporate whereas *Glochidion* has stephanocolporate pollen (Webster, 1994). Brunel suggested an affinity with *Phyllanthus* subg. *Kirganelia* for the species with free stamens, and with *Phyllanthus* subg. *Gomphidium* for the species with con-

nate androecia. He did not, however, study any of the species without valid names in *Phyllanthus*.

While *Glochidion oreichtitum* and *G. sambiranense* were previously published as *Phyllanthus* and have valid combinations in that genus, the remaining five species have no valid names outside *Glochidion*. We were first presented with this problem when identifying Euphorbiaceae collections (cited below under the respective species) made during the recently published botanical inventory (Gautier, 2002) of the Réserve Spéciale de Manongarivo by the Conservatoire et Jardin Botaniques de la Ville de Genève (G). We again encountered the problem while reviewing the Euphorbiaceae chapter in the *Generic Tree Flora of Madagascar* (Schatz, 2001), and when preparing an overview of the Euphorbiaceae of Madagascar for the *Natural History of Madagascar* (Hoffmann & McPherson, 2003).

To correct the false impression that the Asian and Australasian genus *Glochidion* is present in Madagascar, we propose the following new combinations. This paper is intended to clarify the generic boundaries and to make information on the species concerned available to researchers outside the Paris Herbarium. Where necessary, lectotypification will be undertaken in the course of a postgraduate study currently in progress at the University of Antananarivo and the Royal Botanic Gardens, Kew, that will result in a full taxonomic revision of Madagascan *Phyllanthus*.

Phyllanthus ankaratrae (Leandri) Petra Hoffmann & McPherson, comb. nov. Basionym: *Glochidion ankaratrae* Leandri, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 8: 214. 1957. TYPE: Madagascar. Environs d'Ambositra, fôret de Ranomena, *H. Humbert & C. F. Swingle 4845* (MO, P).

Known from the type only.

Phyllanthus humbertii (Leandri) Petra Hoffmann & McPherson, comb. nov. Basionym: *Glochidion humbertii* Leandri, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 8: 215. 1957. TYPE: Madagascar. Pentes orientales du Massif du Marojejy (Nord-Est), à l'ouest de la rivière Manantenina, affluent de la Lokoho, forêt ombrophile sur latérite de gneiss, ± 1450 m, *H. Humbert 22495* (MO, P).

Known from the type only.

Phyllanthus lichenisilvae (Leandri) Petra Hoffmann & McPherson, comb. nov. Basionym: *Glochidion lichenisilvae* Leandri, Notul. Syst. (Paris) 6: 29. 1937. TYPE: Madagascar. Mont Tsaratanana, 2000 m, silve à lichens, *H. Perrier de la Bâthie 16414* (P).

Known from the type only.

Phyllanthus marojejiensis (Leandri) Petra Hoffmann & McPherson, comb. nov. Basionym: *Glochidion marojejiense* Leandri, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 8: 215. 1957. SYNTYPES: Madagascar. Sommet oriental du Massif de Marojejy (Nord-Est) à l'ouest de la haute Manantenina, affluent de la Lokoho, 1850–2137 m, gneiss et quartzite, dans la végétation ericoïde, *H. Humbert 22761* (MO, P); Vallée de la Lokoho (nord-est): mont Beondroka au nord de Maroambihy, 1400–1450 m, rochers de la crête (gneiss et quartzite), *H. Humbert 23608* (P).

Known from the types only.

Phyllanthus perrieri (Leandri) Petra Hoffmann & McPherson, comb. nov. Basionym: *Glochidion perrieri* Leandri, Bull. Soc. Bot. France 81: 606. 1934. TYPE: Madagascar. Massif de Manongarivo, 800–1000 m, bois humides, *H. Perrier de la Bâthie 9918* (P).

Selected further collections. MADAGASCAR. **Antsiranana Province:** Réserve Spéciale de Manongarivo, Bekolosy, 14°02′S, 48°18′E, vallon en amont de la chute de la rivière Bekolosy, 1100 m, *Derleth 117* (G, K, MO); Réserve Spéciale de Manongarivo, Besinkara, 14°04′S, 48°17′E, Ambalafary, 500 m en-dessou du hameau, 300 m, *Gautier & Chatelain 2326* (G, K, MO); Réserve Spéciale de Manongarivo, Besinkara, 14°04′S, 48°17′E, Ambalafary, 250 m, *Gautier 3009* (G, MO); Réserve Spéciale de Manongarivo, above Ambodisakoana, 1100–1200 m, *McPherson & van der Werff 16407* (MO, TAN).

As mentioned above, two of the species listed under *Glochidion* by Leandri (1958) do not need new combinations because Leandri had initially published them in *Phyllanthus*. One of them was first published under the illegitimate name *P. monticola* (1934) but given a nomen novum, *P. oreichtitus*, a year later. The correct citations are as follows:

Phyllanthus oreichtitus Leandri, Cat. Pl. Madag., Euphorb.: 24. 1935. Replaced name: *Phyllanthus monticola* Leandri, Bull. Soc. Bot. France 81: 450. 1934, nom. illeg., non *Phyllanthus monticola* Hutchinson & Dalziel. 1928. *Glochidion oreichtitum* (Leandri) Leandri, Notul. Syst. (Paris) 6: 29. 1937. SYNTYPES: Centre: Andringitra, forêt à mousses et sous-bois herbacé vers 1800 et 2000 m, *H. Perrier de la Bâthie 13670* (P), same locality and collector *14406* (P).

Selected further collections. MADAGASCAR. **Antsiranana Province:** Réserve Spéciale de Manongarivo, Ambahatra, cours supérieur, 13°59′S, 48°26′E, au bord du bras de l'Ambahatra, 900 m à l'W du point côté 1037, 700 m, *Gautier et al. 3499* (G, K, MO). **Antananarivo Province:** 30 km N of Ankazobe, 18°15′S, 47°09′E, remnant patches of plateau forest, 850 m, *Miller & Phillipson 3717* (K, MO).

Phyllanthus sambiranensis Leandri, Bull. Bot. Soc. France 81: 451. 1934. *Glochidion sambiranense* (Leandri) Leandri, Notul. Syst. (Paris) 6: 29. 1937. SYNTYPES: Centre, Haut Bassin du Sambirano, 500 m, quartzites, rocailles, *H. Perrier de la Bâthie 9698* (P); Sources d'Andraronga, versant NE, 1200 m, rocailles, quartzites, *H. Perrier de la Bâthie 9728* (P); Massif de Manongarivo, 1000 m, bois sec, grès liasiques, *H. Perrier de la Bâthie 9917* (P).

Selected further collections. MADAGASCAR. "Chiefly from North-West Madagascar," *Baron 5625* (K). **Antsiranana Province:** Réserve Spéciale de Manongarivo, Belokosy, 14°02′S, 48°18′E, Crête 1 km du sommet, 1390 m, *Gautier & Chatelain 2714* (G, K, MO); Réserve Spéciale de Manongarivo, Belokosy, 14°02′S, 48°18′E, sommet du Belokosy, 1490 m, *Gautier & Derleth 2568* (G, K, MO); Réserve Spéciale de Manongarivo, Ambahatra, cours supérieur, 13°59′S, 48°26′E, crête entre les deux bras de l'Ambahatra, crête principale, 200 m au NNE du point côté 1037, *Gautier et al. 3489* (G, K, MO).

Evaluation of these seven taxa is made difficult by the scarcity of material. Because very few specimens exist outside the Paris herbarium, the main characters are briefly described here. They are woody plants with triangular, non-auriculate cataphylls. All except for *Phyllanthus oreichtitus* are completely glabrous. Leaf shape and size vary greatly between the species, from large (up to 9 × 4 cm) ovate leaves in *P. humbertii* to small (ca. 0.5 × 0.15 cm), falcate leaves in *P. marojejiensis* that give the plant a distinctly ericoid habit. All seven species are monoecious; the cymules are bisexual (*P. humbertii*), or unisexual with staminate and pistillate flowers found on separate branches (*P. sambiranensis*) or the same branch (remaining five species).

The number of sepals in African *Phyllanthus* is usually stable and of diagnostic value (cf. Keay, 1958: 384). Brunel (1987) used this character to define infrageneric groups (series) in *Phyllanthus*. Of the seven species in question, *Phyllanthus oreichtitus* always has six sepals, *P. ankaratrae* has five sepals in staminate and six sepals in pistillate flowers, and the remaining species have five sepals in both sexes. The shapes of the staminate sepals and disc are similar in all seven species; discrete alternisepalous disc glands are always developed.

Androecium morphology divides the seven species under consideration in two groups. The first group comprises *Phyllanthus ankaratrae, P. humbertii, P. lichenisilvae,* and *P. marojejiensis* with completely connate stamens, and in this way resembles true *Glochidion*. *Phyllanthus ankaratrae* and *P. humbertii* have three stamens with non-apiculate anthers, whereas the androecium of *P. lichenisilvae* consists of four stamens with a central apiculum, and *P. marojejiensis* has five stamens with individual apicula. The remaining three species have free stamens, numbering five in *P. perrieri* and *P. sambiranensis,* and six in *P. oreichtitus*. Anthers are much longer than wide in all species and always dehisce longitudinally.

Pistillate pedicels of these seven species vary greatly in length from 1 to 15 mm. The pistillate disc is extremely reduced to lacking (*Phyllanthus ankaratrae* and *P. humbertii*), distinct and annular-pentagonal (*P. lichenisilvae*), irregularly dissected (*P. oreichtitus*), or consists of discrete, minute alternisepalous lobes (*P. marojejiensis, P. perrieri,* and *P. sambiranensis*). The ovary is uniformly glabrous and three-locular.

Great variation is found in styles and stigmas. *Phyllanthus perrieri* stands out in having erect, terete, entire styles up to 1.5 mm long that appear to be fused at least apically. It was the first Madagascan species to be described as *Glochidion* (Leandri, 1934), mainly because of the fused styles, as is the case in true *Glochidion*. The styles and stigmas of the remaining six species classified as *Glochidion* by Leandri (1958) are free and no more than 0.5 mm long, and of two principal shapes. In the first three species of this group, the short styles are more or less terete and bifid. In *P. ankaratrae* and *P. oreichtitus* they are inserted centrally and are apically reflexed, whereas the styles of *P. lichenisilvae* arise off-center and lean inward. In the remaining three species under consideration the styles seem to be reduced and there are three rather large, entire, flat stigmas. In *P. humbertii* and *P. marojejien-*

sis these arise centrally and are spread flat against the ovary, whereas *P. sambiranensis* has similar but excentric, inward-leaning stigmas.

Fruits and seeds are unknown in *Phyllanthus ankaratrae* and *P. lichenisilvae*, and no seed has been seen of *P. marojejiensis*. Where known, fruits are smooth capsules, and the seeds are uniformly triquetrous with a distinct elliptical, usually slightly impressed but not invaginated chalaza and a smooth dry seed coat.

It is obvious from this morphological discussion that the Madagascan species of *Phyllanthus* united by Leandri as *Glochidion* show considerable diversity. They represent distinct species with unique combinations of characters although the distinctiveness of the infraspecific entities *G. oreichtitum* subsp. *tsaratanense* Leandri and *G. sambiranense* var. *trapezophyllum* Leandri is questionable.

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Delphinium lihengianum (Ranunculaceae), a New Species from Xizang, China

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ABSTRACT. *Delphinium lihengianum* Q. E. Yang & Y. Luo, a new species of the Ranunculaceae from Yadong County, Xizang, is described and illustrated. This new species is similar to *D. caeruleum* Jacquemont, especially in the indumentum of the stem and pedicels and in the leaf divisions, but differs in having the staminodes bifid to the middle and three carpels.

Key words: China, *Delphinium*, Ranunculaceae, Xizang.

During the second author's visit to the Royal Botanic Gardens, Kew, from December 2001 to June 2002, the type specimen of *Delphinium nortonii* Dunn (1927), *E. F. Norton 369*, which was collected from the sandy soil above Kampa Dzong, 12 miles north of Sikkim, Xizang, was carefully examined. The sheet includes six perfect, small plant individuals, which have one to three large inflated-globose flowers and black-brown staminodes. Because of these two characters *D. nortonii* should be a member of *D.* subg. *Delphinastrum* (DC.) Petermann sect. *Elatopsis* Huth. However, Wang (1962) placed *D. nortonii* in *D.* subg. *Delphinastrum* sect. *Delphinastrum*, citing only one specimen, *P. C. Tsoong 5950*, from Chumbi, Yadong County, southeastern Xizang, under this species and stating that he did not see its type specimen. This treatment was followed by Wang (1979) and Wang and Warnock (2001). As the members in section *Elatopsis* are different from those in section *Delphinastrum* in the color of the staminodes, we suspected that the plant referred to *D. nortonii* by Wang (1962), *P. C. Tsoong 5950*, probably represented a misidentification, and thus its identity should be redetermined. Close examination of this specimen in the Herbarium of the Institute of Botany, Chinese Academy of Sciences (PE), which includes two plants mounted on one sheet, has shown that it represents an undescribed species.

Delphinium lihengianum Q. E. Yang & Y. Luo, sp. nov. TYPE: China. Xizang: Yadong County, Chumbi, meadow in forest, July 1953 (fl), *P. C. Tsoong 5950* (holotype, PE). Figure 1.

Herba perennis; caule gracili, 12–22 cm alto, terete, ca. 1 cm diametro, adpresse pubescente, simplici vel 1-ramoso, 2–3-foliato. Folia caulina inferiora longe petiolata; petiolo 3.2–5 cm longo, adpresse pubescente, basi anguste vaginato; lamina utrinque sparse sericea, ambitu orbiculari-pentagona, ca. 3 cm lata, trisecta, partitione centrali rhombica tripartita fere usque ad costam, lobulis lineari-lanceolatis vel linearibus 1–2 mm latis, partitionibus lateralibus oblique tetragonis inaequaliter 4-partitis fere usque ad basim, lobis inaequaliter bifidis. Folia caulina superiora minora. Flores singuli ad apicem caulis vel apicem rami, 3.3–3.7 cm longi; pedicellis adpresse pubescentibus, infra medium 2-bracteolatis, bracteolis linearibus, 1–3.3 cm longis, sessilibus vel breviter stipitatis; sepalo superiore caeruleo, elliptico vel elliptico-ovato, 1.6–1.8 cm longo, extus pubescente, calcari cylindrico-subulato, 1.7–1.9 cm longo, recto vel apice leviter deorsum curvato, sepalis lateralibus late ellipticis, ca. 2 cm longis, ca. 10 mm latis, sepalis inferioribus ellipticis, ca. 2 cm longis, ca. 5 mm latis; petalis in sicco brunneo-flavis, glabris, apice emarginatis; staminodiis caeruleis, limbo paulo longiore quam ungue, elliptico-obovato, bifido usque ad medium, margine sparse ciliato, adaxialiter flavido-barbato; staminum filamentis sparse puberulis vel glabris; carpellis 3, dense brunneo-villosis.

Perennial herbs. Stem slender, 12–22 cm tall, terete, ca. 1 cm diam., adpressed pubescent, simple or 1-branched, 2- to 3-leaved. Lower cauline leaves long-petiolate; petiole 3.2–5 cm long, adpressed pubescent, base narrowly vaginate; leaf blade sparsely sericeous on both surfaces, orbicular-pentagonal in outline, ca. 3 cm wide, trisect, central lobe rhombic, tripartite nearly to midvein, lobules linear-lanceolate or linear, 1–2 mm wide, lateral lobes obliquely tetragonal, unequally 4-partite nearly to base, lobules unequally bifid. Upper cauline leaves smaller. Flowers singular at apex of stem or of branch, 3.3–3.7 cm long; pedicel adpressed pubescent, 2-bracteolate below middle;

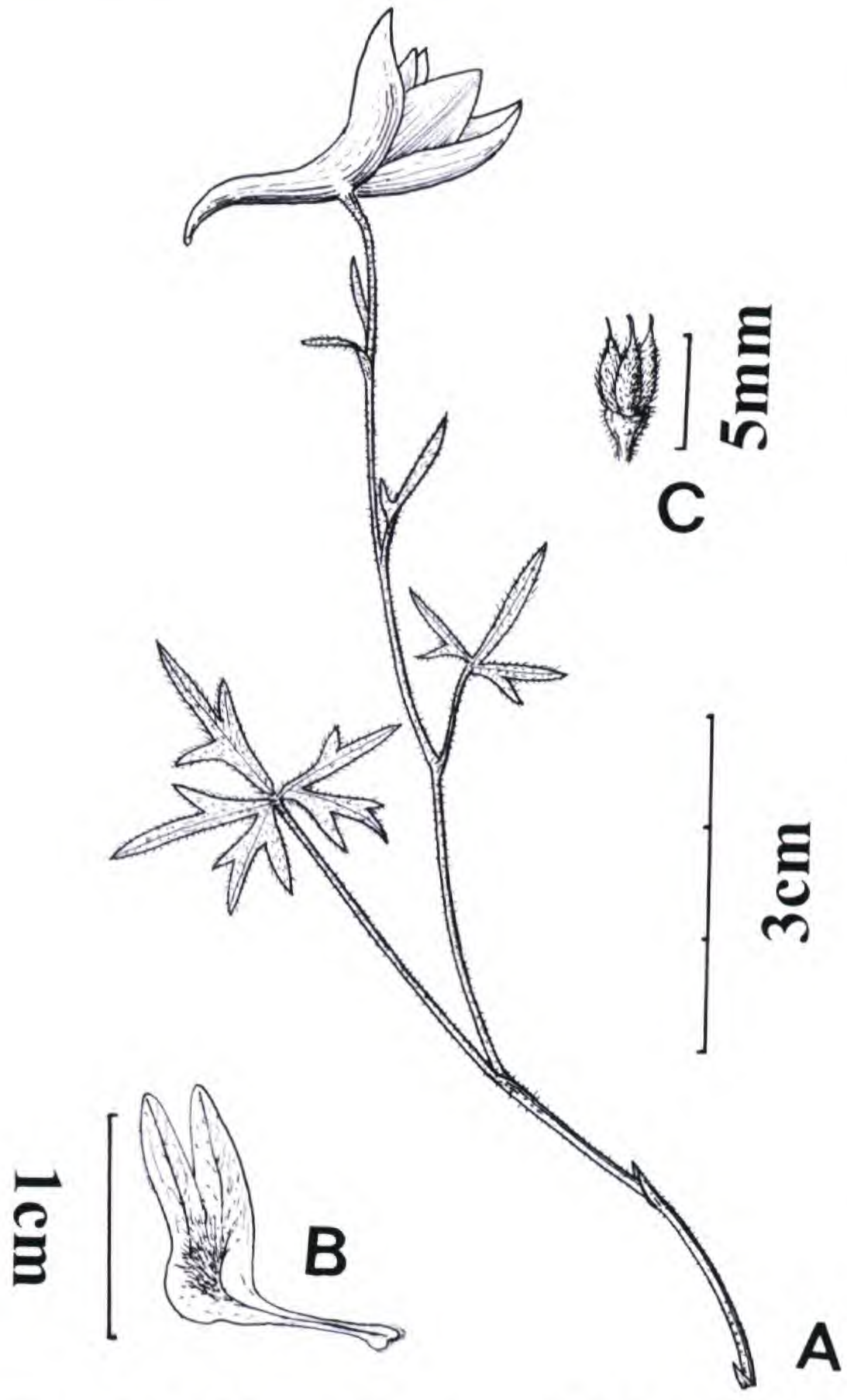

Figure 1. *Delphinium lihengianum* Q. E. Yang & Y. Luo. —A. Habit. —B. Staminode. —C. Carpels. Drawn from the type, *P. C. Tsoong 5950* (PE).

bracteoles linear, 1–3.3 cm long, sessile or shortly stipitate. Upper sepal blue, elliptic or elliptic-ovate, 1.6–1.8 cm long, pubescent outside; spur cylindric-subulate, 1.7–1.9 cm long, straight or apex slightly downcurved; lateral sepals broadly elliptic, ca. 2 × ca. 1 cm; lower sepals elliptic, ca. 2 cm × ca. 5 mm. Petals brown-yellow when dry, glabrous, apex emarginate. Staminodes blue; limb slightly longer than claw, elliptic-obovate, bifid to middle, margin sparsely ciliate, ventrally yellow barbate. Stamen filaments sparsely puberulous or glabrous. Carpels 3, densely brown villose.

Distribution and habitat. *Delphinium lihengianum* is only known from its type locality, Yadong County in southeastern Xizang, China, a border area between China, Bhutan, and Sikkim, which is not easily accessible. According to the collector's note, this species grows in meadows in forest. Fieldwork needs to be done to know more about the habitat of this species.

Taxonomic remarks. *Delphinium lihengianum* is possibly related to *D. caeruleum* in usually having a slender and adpressed pubescent stem, adpressed pubescent pedicels, and 3-sect leaves with linear or linear-lanceolate lobules, but differs in having staminodes bifid to the middle and three carpels. Its systematic position is far from *D. nortonii*, which is distinguishable by its one to three large inflated-globose flowers and black-brown staminodes. In the original description, Dunn did not mention the color of the staminodes, an important character in the classification of the genus *Delphinium*. Our new species, *D. lihengianum*, which has 3-sect leaves with linear or linear-lanceolate lobules, blue staminodes, and the flower solitary at the apex of the main stem or branch, should be a member of subgenus *Delphinastrum* sect. *Delphinastrum* ser. *Caerulea* W. T. Wang.

This species is named in honor of Professor Li Heng from the Kunming Institute of Botany, Chinese Academy of Sciences, who provided valuable guidance for the second author's professional career.

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Luisma, a New Genus of Grammitidaceae (Pteridophyta) from Colombia

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ABSTRACT. We describe and illustrate a monotypic new genus and species of fern, *Luisma bivasculare* M. T. Murillo & A. R. Smith (Grammitidaceae), endemic from the Colombian Andes. *Luisma* is similar to narrow-leaved species of *Campyloneurum* (Polypodiaceae). However, it agrees with grammitid ferns in having green, trilete spores (vs. hyaline or yellowish, monolete spores in nearly all Polypodiaceae) and free veins (vs. anastomosing in *Campyloneurum*). From all Grammitidaceae, *Luisma* differs in having two petiolar bundles. Other distinguishing characters include suberect, radially symmetrical rhizomes, sparse hyaline stipe hairs, adaxial hydathodes, and clathrate, setulose rhizome scales.

RESUMEN. Nosotros describimos e ilustramos un nuevo género y especie de helecho monotípico, *Luisma bivasculare* M. T. Murillo & A. R. Smith (Grammitidaceae), endémico de los Andes colombianos. *Luisma* es similar a especies de *Campyloneurum* (Polypodiaceae) con hojas angostas. Sin embargo, concuerda con las gramitidáceas por tener esporas verdes, triletes (vs. esporas hialinas o amarillentas en casi todas las Polypodiaceae) y venas libres (vs. anastomosadas en *Campyloneurum*). De todas las Grammitidaceae *Luisma* difiere por tener dos haces peciolares. Otros caracteres que lo distinguen incluyen un rizoma radialmente simétrico, con pelos hialinos esparcidos en el estípite, hidatodos adaxiales y escamas del rizoma clatradas, setulosas.

Key words: Colombia, Grammitidaceae, *Luisma*.

In this paper we describe a new genus of Grammitidaceae in Colombia. A number of recent papers establish a generic framework for the family in the Neotropics. These include revisions or synoptical treatments of *Ceradenia* (Bishop, 1988), *Cochlidium* (Bishop, 1978), *Enterosora* (Bishop & Smith, 1992), *Grammitis* sensu stricto (Bishop, 1977), *Lellingeria* (Smith et al., 1991), *Melpomene* (Smith & Moran, 1992), *Micropolypodium* (Smith, 1992), *Terpsichore* (Smith, 1993), and *Zygophlebia* (Bishop, 1989). Prior to these studies, Copeland (1952a, 1952b, 1955) dealt with various elements of Neotropical Grammitidaceae in a synoptical way, and Morton (1967) and Smith and Moran (in Moran & Riba, 1995) treated grammitids from adjacent Ecuador and from Mesoamerica, respectively.

Discovery of a new genus of ferns, based solely on previously undescribed species, is an uncommon event, notwithstanding several exciting discoveries in the last two years. Sun et al. (2001) recently described a new genus and species (*Mankyua chejuense* B.-Y. Sun et al.) of the eusporangiate fern family Ophioglossaceae from Cheju Island, Korea. Even more recently, *Caobangia squamata* (Polypodiaceae) has been described as a new genus and species from Vietnam (Smith & Zhang, 2002). In the Neotropics, the last such monotype named was *Nephopteris maxonii* Lellinger (1966), a poorly known plant (still known only from the type) from Colombia, a country generally acknowledged to be among the richest for ferns (as well as vascular plants) in the Neotropics, and also among the richest in the world (Cuatrecasas, 1958; Gentry, 1982; Moran, 1996; Rangel-Ch., 2000; Hammen, 1995). Below we describe another monotypic genus, *Luisma*, with its sole species *L. bivasculare*. The genus is known only from the type.

Luisma bivasculare M. T. Murillo & A. R. Smith, gen. et sp. nov. TYPE: Colombia. Risaralda: Municipio de Mistrató, entre los corregimientos de Geguadas y Puerto de Oro, selva de pisones, 1550 m, zona de bosque pluvial premontano, bosque primario, 30 mar. 1992, *J. L. Fernández 9613* (holotype, COL 468054). Figure 1.

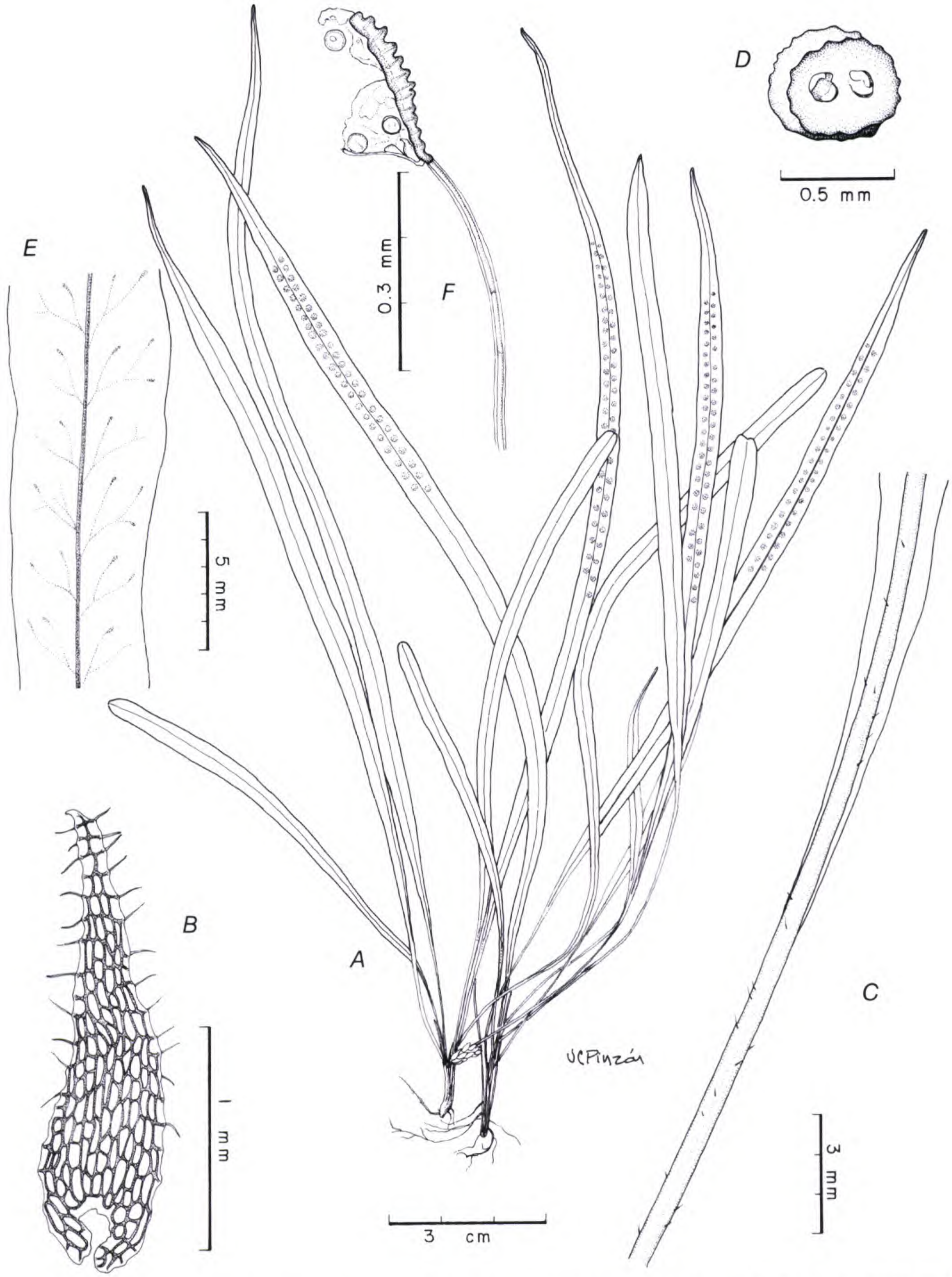

Figure 1. *Luisma bivascularis* M. T. Murillo & A. R. Smith, gen. et sp. nov., based on *J. L. Fernández 9613* (COL). —A. Plant habit. —B. Rhizome scale. —C. Petiole and blade base. —D. Petiole, in cross section, showing two vascular bundles. —E. Venation of a portion of the blade. —F. Sporangium, with spores.

Plantae epiphyticae. Rhizomata radialiter symmetrica, erecta vel suberecta, apice squamata, squamis fumeis, nitentibus, clathratis, usque 2.2 × 0.25 mm, lanceolatis, basi peltatis ad marginem ciliatis, ciliis 0.05 mm longis, hyalinis. Stipites teretes, basi cum duo fascibus vascularibus in sectione transversali, 16–25 × 0.3–0.4 mm, fusci, trichomatibus hyalinis simplibus, phyllopodiis carentibus. Laminae prasinae in statu sicco, anguste ellipticae, 9–20 × 0.3–0.4 cm, membranaceae, basi et apice longiattenuatae, margine integrae; costae venaeque glabrae utrinque; nervi libri, 2–3-furcati; hydathodi adaxialiter prominentes ellipticae. Sori rotundati, ca. 1 mm diam., confinis costae, uniseriales in lateribus ambabus costae, paraphysibus absentibus, capsulis sporangiorum glabris. Sporae virides, globosae, 30–36 μm diam. (in acido lacteo), triletae.

Plants epiphytic. Rhizomes radially symmetrical, erect or suberect, scaly at the apex, scales smoky dark gray, shining, clathrate, up to 2.2 × 0.25 mm, lanceolate, peltate at the base, margins ciliate, cilia 0.05 mm long, hyaline. Stipes terete, darkened (brownish), at the base with two vascular bundles in cross section, 16–25 × 0.3–0.4 mm, trichomes hyaline, simple; phyllopodia absent. Blades greenish in the dried state, narrowly elliptic, 9–20 × 0.3–0.4 cm, membranaceous, at the base and apex long-attenuate, at the margins entire, midribs and veins glabrous on both sides; nerves free, forked; hydathodes adaxially prominent, elliptical. Sori round, ca. 1 mm diam., adjacent to (touching) the midrib, uniseriate on each side of the costa, lacking paraphyses; sporangial capsules glabrous. Spores green, globose, 30–36 μm diam. (in lactic acid), trilete.

Etymology. The genus is dedicated to Luis Maria Murillo (father of the first author), pioneer in entomology in Colombia and author of many scientific works. He was one of the founders in 1929 of the Academia Colombiana de Ciencias Exactas, Físicas y Naturales, and editor of the journal for 10 years (1952–1961). He belonged to the Sociedad Colombiana de Geografía, was an honorary member of the Sociedad Real Entomológica de Bélgica, and founded the Instituto de Altos Estudios del Gobierno Nacional. After more than 40 years of continuous service in the Ministry of Agriculture as "Jefe de Sanidad Vegetal", Colombia's President Alberto Lleras Camargo conferred the Cruz de Boyacá in 1962, in recognition of his outstanding work and exceptional scientific merits. We cite some of his many publications (Murillo, 1937, 1944, 1951, 1956).

The species epithet refers to the petioles, which in cross section have two vascular bundles; this is the only genus known in Grammitidaceae that has this vascular configuration. The implications of this finding for the phylogenetic position of *Luisma* within the Grammitidaceae remain intriguing but unknown, at present.

Habitat and distribution. The type locality is a subandean pluvial forest, where the environment is favorable for the existence of diverse plant life, including numerous epiphytes, ferns, mosses, lichens, aroids, and orchids. In this area there have been found recently several new bird species, in *Vireo* (Salaman & Stiles, 1996) and *Glaucidium* (Robbins & Stiles, 1999); a new lepidopteran insect, *Antirrhea* (Andrade, 1993); a new tree species in the genus *Matisia*, Bombacaceae (Fernández-Alonso, 2001); and a new *Columnea*, Gesneriaceae (Amaya-Márquez, 2002).

The species is known from only a single collection, and is seemingly rare. However, the locality is relatively inaccessible, and the great floristic diversity of the region, as well as the paucity of collections from the area, may obscure the fact that it could be locally common. More likely, it is of very restricted occurrence.

At first glance, *Luisma bivascularis* looks like a species of *Campyloneurum* (Polypodiaceae), but in studying the characters further, we conclude that it has no close affinity with that genus. Clearly, the species is a member of the Grammitidaceae because of its chlorophyllous (green) trilete spores and free veins (although a few Polypodiaceae sensu stricto also have free veins, e.g., some species of *Polypodium* and also *Pecluma*, and a few grammitids have anastomosing veins, e.g., *Zygophlebia*). Also the rhizome scales, which are strongly clathrate and with hyaline marginal setulae, are reminiscent of *Lellingeria* (Grammitidaceae) and unlike anything known in Polypodiaceae. The rhizomes appear to be radially symmetrical and suberect, like some grammitid ferns but unlike almost all Polypodiaceae. We are unable to place the specimen in any known genus of Grammitidaceae in either the Neotropics or Paleotropics. From all known genera and species of Grammitidaceae, *Luisma bivascularis* differs in having two vascular bundles in the petioles. Many species of grammitids have been checked for this character (Parris, 1990; A. R. Smith & B. S. Parris, unpublished data), including some that are larger than *Luisma*. In addition, *Luisma* differs from the largely Neotropical genera *Ceradenia*, *Enterosora*, and *Zygophlebia* in having veins ending in prominent hydathodes adaxially. *Luisma* further differs from *Ceradenia* in having clathrate rhizome scales and from *Zygophlebia* in lacking distinct phyllopodia.

From *Terpsichore*, *Melpomene*, and *Micropolypodium*, other Neotropical grammitid genera, *Luisma* differs in lacking long reddish or red-brown setae

on the blades and petioles; in fact, the fronds of *Luisma* are nearly glabrous or with only sparse whitish hairs on the stipes. *Melpomene* further differs in having entire marginal rhizome scales and pinnatifid to pinnatisect leaves. Like *Micropolypodium* and some species of *Terpsichore*, *Luisma* has hyaline marginal setae on the rhizome scales, but it differs from all species in those genera in having entire leaves. From *Lellingeria*, which has similar rhizome scales, *Luisma* differs in its simple, entire blades, lack of forked hairs on the stipes and rachises, and generally quite glabrous blades.

Other simple-bladed species of Grammitidaceae in the Neotropics include *Cochlidium*, the species of which have dull, concolorous, orange to tan, entire rhizome scales; *Grammitis*, with species having black sclerenchymatous margins and lustrous, concolorous, orange to tan, entire rhizome scales; and *Lomaphlebia* (Greater Antilles), with anastomosing veins and rhizome scales similar to those of *Cochlidium* and *Grammitis*. American species of *Grammitis* sensu stricto lacking a black margin occur in southern South America, but these have orangish, concolorous, entire rhizome scales and are very small-bladed species, generally less than ca. 5 cm long. We do not believe that any American genus of Grammitidaceae is closely related to *Luisma*, nor can we demonstrate that any Old World genus of Grammitidaceae has close relationships. Without molecular data, the closest affinities of *Luisma* will probably remain obscure, and we believe it likely that *Luisma* is one of the most isolated species and genera in the family, phylogenetically.

Artificial Key to Genera of Grammitidaceae in Colombia

1a. Blades entire, deeply serrate, crenate, or broadly and shallowly lobed.
  2a. Petioles each with two vascular bundles; rhizome scales clathrate, with ciliate margins . . . . . *Luisma*
  2b. Petioles each with a single vascular bundle; rhizome scales non-clathrate, entire or at least not ciliate.
    3a. Blade margins sclerified, dark brown or black . . . . . *Grammitis*
    3b. Blade margins not sclerified, greenish or yellowish.
      4a. Rhizomes radially symmetrical; blades entire to deeply serrate, usually less than 5 mm wide; hydathodes evident or not adaxially . . . . . *Cochlidium*
      4b. Rhizomes dorsiventral; blades entire, crenate, or broadly lobed, usually more than 5 mm wide; hydathodes absent adaxially . . . . . *Enterosora*
1b. Blades pinnatifid, pinnatisect, or 1-pinnate.
  5a. Hydathodes absent adaxially.
    6a. Veins free; opaque whitish stalked glands borne in sori and sometimes also on blades . . *Ceradenia*
    6b. Veins areolate; opaque whitish glands lacking in sori and on blades . . . . . *Zygophlebia*
  5b. Hydathodes present adaxially.
    7a. Rhizome scales not clathrate.
      8a. Blades less than 1 cm wide, with one sorus per segment; main veins in segments (pinnae) simple or with a single acroscopic branch; rhizomes radially symmetric . . . . *Micropolypodium*
      8b. Blades usually more than 1 cm wide, with more than one sorus per segment; main veins in segments (pinnae) pinnately branched; rhizomes dorsiventral to radial . . . . . *Terpsichore*
    7b. Rhizome scales usually strongly clathrate.
      9a. Setae lacking on margins of scales, but sometimes with several minute papillae at scale tips . . . . . *Melpomene*
      9b. Setae on margins of scales hyaline to reddish.
        10a. Cell luminae clear; blades lacking black clavate fungal fruiting bodies . . . . . *Lellingeria*
        10b. Cell luminae darkened; blades often with black clavate fungal fruiting bodies, especially along rachises, costae, and among sporangia . . . . . *Terpsichore*

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Notes on Grasses (Poaceae) for the *Flora of China*, I: *Deyeuxia*

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Abstract. Two problematical species from the Himalaya that lie on the boundary between *Agrostis* and *Deyeuxia* are discussed. One is transferred to *Deyeuxia* as *Deyeuxia petelotii* with the new synonym *D. continentalis*. The name *Deyeuxia abnormis* J. D. Hooker is retained for the second species, which is confirmed as distinct from *D. zenkeri*. Two other species are transferred to *Deyeuxia* from *Calamagrostis*: *Deyeuxia sichuanensis* and *Deyeuxia korotkyi*.

Key words: *Aniselytron*, *Calamagrostis*, China, *Deyeuxia*, Himalaya, Poaceae.

The genera *Agrostis* L., *Calamagrostis* Adanson, and *Deyeuxia* Clarion ex P. Beauvois form an intergrading complex of three incompletely separated entities. Treatments of this complex vary considerably, even in recent works, so it has been necessary to carefully consider the options for the treatment for the *Flora of China*.

Agrostis has always been maintained separately, while *Calamagrostis* and *Deyeuxia* are either maintained separately or *Deyeuxia* is sunk into *Calamagrostis*. *Calamagrostis* and *Deyeuxia* are kept separate by S. L. Lu (1987) in *Flora Reipublicae Popularis Sinicae*, but united by Koyama (1987) in his treatment of the Japanese flora. They are united by Tzvelev (1976) for the former Soviet Union, but kept separate by Bor (1960) for the Indian subcontinent and Veldkamp (1996) for Malesia. Simon (1993) kept them separate in Australia and also Rugolo de Agrasar (1978) in South America. There is no consistency within Chinese provincial Floras. For example, *Deyeuxia* was maintained in *Flora Qinghaiica* by Lu (1999), but sunk in *Flora Sichuanica* by J. L. Yang (1988).

Although *Agrostis* has always been maintained separately, the boundaries between *Agrostis* and both *Calamagrostis* and *Deyeuxia* are just as ill-defined as that between *Calamagrostis* and *Deyeuxia*. It therefore seems logical to us that either one large genus with sections is recognized, or else three segregate genera, but not a halfway position of two genera. We prefer to recognize three genera to avoid an unwieldy conglomerate, while acknowledging that some species will cause problems. This also follows the treatment of the complex for China by Lu (1987), and avoids the need for many new combinations in *Calamagrostis*. Following this concept, most species of *Calamagrostis* sensu lato are referable to *Deyeuxia*. The genus *Calamagrostis* sensu stricto is confined to relatively few north temperate species.

The majority of species in the complex can be placed in one of the three genera without difficulty, according to the following key:

1a. Glumes clearly shorter than floret.
  2a. Lower glume up to 1/2 floret length, usually much shorter or vestigial; rachilla extension minute, glabrous . . . . . *Aniselytron*
  2b. Lower glume 1/2 floret length or more; rachilla extension distinct, penicillate . . . *Deyeuxia*
1b. Glumes equaling or longer than floret.
  3a. Spikelets usually less than 5 mm; callus glabrous or shortly hairy; lemma hyaline; rachilla extension often absent . . . . . *Agrostis*
  3b. Spikelets often more than 5 mm; callus bearded, hairs 1/3 as long as to longer than floret (if shorter, penicillate rachilla extension present); lemma membranous to firm; rachilla extension present or absent.
    4a. Lemma at least 3/4 as long as glumes, usually firm; callus hairs almost as long as to clearly shorter than floret; rachilla extension present, penicillate . . *Deyeuxia*
    4b. Lemma 1/2–2/3 as long as glumes, membranous; callus hairs often much exceeding floret; rachilla extension absent, or if present glabrous or shortly hairy . . . . . *Calamagrostis*

There are a number of troublesome intermediates, and it must be stressed that no character combinations provide a definitive way for assigning all the species in this group. Two such problematical species, *Deyeuxia petelotii* (Hitchcock) S. M. Phillips & W. L. Chen and *D. abnormis* J. D. Hooker,

which we have had to consider for the *Flora of China* account, are discussed below. They lie on the boundary between *Agrostis* and *Deyeuxia*, with an open panicle of small spikelets as in *Agrostis*, but a bearded callus and penicillate rachilla extension as in *Deyeuxia*. Two other species are transferred here from *Calamagrostis* to *Deyeuxia*.

A few intermediate and outlying species from this complex have been described in two other genera, *Aniselytron* Merrill and *Aulacolepis* Hackel. The small Asian genus *Aniselytron* was revised by Korthof and Veldkamp (1984 [1985]), and is discussed below under *D. petelotii*. *Aulacolepis* Hackel (1907) is illegitimate, as it is a later homonym of *Aulacolepis* Ettingshausen (1893). Under our generic concept, its species are divided between *Aniselytron* and *Deyeuxia*.

Deyeuxia petelotii (Hitchcock) S. M. Phillips & W. L. Chen, comb. nov. Basionym: *Aulacolepis petelotii* Hitchcock, J. Wash. Acad. Sci. 24: 291. 1934, gen. illegit. *Aniselytron petelotii* (Hitchcock) Soják, Cas. Nar. Muz. Praze, Rada Prir. 148: 202. 1979 [1980]. *Neoaulacolepis petelotii* (Hitchcock) Rauschert, Taxon 31: 561. 1982. *Agrostis petelotii* (Hitchcock) Noltie, Edinburgh J. Bot. 56: 386. 1999. *Calamagrostis petelotii* (Hitchcock) Govaerts, World Checkl. Seed Pl. 3: 11. 1999. TYPE: Vietnam. Tonkin: near Chapu, ca. 1900 m, Aug. 1933, *A. Pételot 4743* (holotype, US; isotype, P).

Agrostis continentalis Handel-Mazzetti, Symb. Sin. 7: 1297, t. 40 f. 2. 1936. Syn. nov. *Deyeuxia continentalis* (Handel-Mazzetti) L. Liou, Vasc. Pl. Hengduan Mountains 2: 2240. 1994. TYPE: China. Yunnan: between Yuanmou and Hailo, 1050–1350 m, 10 Oct. 1914, *H. Handel-Mazzetti 5018* (holotype, W).

Anisachne gracilis Keng, J. Wash. Acad. Sci. 48: 117. 1958. *Aniselytron gracilis* (Keng) N. X. Zhao, J. Trop. & Subtrop. Bot. 3(2): 50. 1995. TYPE: China. Guizhou: Pichieh, 1400 m, 1 June 1943, *Hou Hsueh-yuh 2143* (holotype, N not seen).

Anisachne gracilis var. *multinodis* Y. Y. Qian, Bull. Bot. Res., Harbin 18: 398. 1998. TYPE: China. Yunnan: Lancang, 1900 m, 24 Nov. 1993, *Qian Yi-yong 3154* (holotype, HITBC; isotypes, NEFU, SMAO none seen).

Distribution. Northeastern India, Bhutan, China (Guizhou, Yunnan), North Vietnam.

Deyeuxia petelotii appears to be widespread from northeastern India through southern China to northern Vietnam, at elevations of 1000–3400 m. It has been described as new several times within this area, and its anomalous generic position can be seen from the synonymy above. We agree with L. Liou (1994) that it is best placed in *Deyeuxia* because of its bearded callus and penicillate rachilla extension. The description of the rachilla as naked in Hitchcock's (1934) protologue is a mistake. The tip is bare, but there are long hairs on its lower half. Liou made the transfer based on *Agrostis continentalis* Handel-Mazzetti, a name that has hitherto been missed by authors outside China. However, this is predated by *Aulacolepis petelotii* Hitchcock from Vietnam.

In *Deyeuxia petelotii* the lemma usually slightly exceeds the glumes, or at least the lower glume, as depicted in the figure accompanying the protologue of *Anisachne gracilis* Keng (1958: 118). A paratype specimen, *Liu Tchen-ngo 21012* (PE), has been seen. Keng (1958) described his new genus *Anisachne* on the basis of the glumes being a little shorter than the lemma. He acknowledged that otherwise he would refer it to *Deyeuxia*. Although the glumes are usually longer than the lemma in *Deyeuxia*, shorter glumes are also seen in a few species from Australia and New Guinea. Vickery (1940) and Simon (1993) both placed these short-glumed Australian species in *Deyeuxia*. A further complication is that spikelets affected by nematode infection may have abnormally elongated lemmas, as noted by Noltie (2000: 600) and seen by the second author in *D. holciformis* (Jaubert & Spach) Bor and *D. scabrescens* Grisebach in southwestern China.

These slightly short-glumed species of *Deyeuxia* should not be equated with the situation in the small genus *Aniselytron*, where the glumes are both very much shorter than the floret, with the lower glume sometimes vestigial. *Aniselytron* is further distinguished by its short glabrous rachilla extension. We agree with the concept of *Aniselytron* as set out by Korthof and Veldkamp (1984 [1985]), comprising two species, *A. treutleri* (O. Kuntze) Sojàk and *A. agrostoides* Merrill, both of which occur in China. *Aniselytron* is placed in synonymy under *Calamagrostis* by Clayton and Renvoize (1986: 135), and this treatment is followed by Noltie (2000: 617), although in a note he implicitly agreed with Korthof and Veldkamp that *Aniselytron* merits separate generic status.

It has not been possible to see the type of *Anisachne gracilis* var. *multinodis* Y. Y. Qian. The figure in the protologue shows the floret longer than the glumes, as in *D. petelotii*, but the habit is more typical of *D. abnormis*.

Deyeuxia abnormis J. D. Hooker, Fl. Brit. India 7: 268. 1897 [1896]. *Calamagrostis abnormis* (J. D. Hooker) U. Shukla, Grasses N.-East. India: 45. 1996. TYPE: India. Khasia, Nonkreem, Oct. 1850, *J. D. Hooker & T. Thomson s.n.* (lectotype, designated by Noltie (1999: 386, *Agrostis 12*, right-hand specimen "B"), K).

Agrostis nagensis Bor, Kew Bull. 9: 497. 1954. *Deyeuxia nagensis* (Bor) Veldkamp, J. Econ. Tax. Bot. 13: 74. 1989. TYPE: NE India. Nagaland, Japvo, 28 Sep. 1935, *N. L. Bor 6449* (holotype, K).

Distribution. Northeastern India, Bhutan, China (Yunnan).

Deyeuxia abnormis is very similar to *D. petelotii,* as recognized by Keng when describing *Anisachne.* The two have often been confused, especially in northeastern India where both may grow together. The confusion dates back to Hooker (1896: 268), although it seems likely that he did distinguish them in the field as he assigned two species numbers, Agrostis nos. 11 & 12 (these are not collection numbers). All elements of the protologue of *D. abnormis* at Kew, except two of the three sheets of Hooker & Thomson Agrostis 12, are indeed *D. abnormis.* Two of the sheets of Agrostis 12 are *Agrostis petelotii,* and the third is a mixture of both species, with the right-hand specimen "B" being *D. abnormis.* Noltie (1999: 386) lectotypified *D. abnormis* on this right-hand specimen "B" of the mixed sheet, correcting a previous wrong lectotypification by Bor. Bor (1960: 392) recognized only one species, *D. abnormis* (under the name *Agrostis zenkeri,* see below). However, close inspection clearly reveals that two species are involved. Their distinguishing features have been set out by Noltie (1999: 387), and the main points are summarized below:

Spikelets 1.9–2.5(–3) mm; glumes slightly shorter than floret; callus hairs < 1 mm, not visible between glumes; leaf sheaths smooth . . . *D. petelotii*
Spikelets 2.5–3.5 mm; glumes equaling or longer than floret; callus hairs 1.2–2 mm, visible between glumes; leaf sheaths scabrous . . . . . *D. abnormis*

The name *Deyeuxia abnormis* has frequently been treated as a synonym of *Agrostis zenkeri* Trinius (1841). Veldkamp transferred *A. zenkeri* to *Deyeuxia* as *A. zenkeri* (Trinius) Veldkamp (1985), and Davidse placed it in *Calamagrostis* as *C. zenkeri* (Trinius) Davidse (1994). However, we regard this as a different, little-known species, probably from southern India.

The type of *Agrostis zenkeri* (holotype, LE) consists of a single flowering culm without basal parts. There is a photograph of the type at Kew and a full description by Veldkamp (Korthof & Veldkamp, 1984 [1985]: 219). As pointed out by Noltie (1999: 384), much has already been written about the correct identity of this taxon, but it is necessary to add a further note here. Veldkamp was unable to equate it with any species known to him, following J. D. Hooker (1896: 258) who many years earlier listed it as a doubtful species.

Bor (1954, 1960) thought the type specimen of *Agrostis zenkeri* represented the same species as specimens from northeastern India described as *Deyeuxia abnormis* by Hooker. This view has been generally followed and was accepted by Noltie (1999, 2000). However, we find that the type of *A. zenkeri* differs from material of *D. abnormis* in several important respects as follows:

Palea 2/3 as long as lemma; anthers ca. 0.8 mm; callus hairs 1.2–1.8 mm . . . . . *Deyeuxia abnormis*
Palea as long as or slightly longer than lemma; anthers ca 1.2 mm; callus hairs ca. 1 mm . . . . . *Agrostis zenkeri*

Therefore, we disagree with Bor and Noltie that *Deyeuxia abnormis* should be treated as a synonym of *A. zenkeri,* but instead agree with Veldkamp that *A. zenkeri* is a species of uncertain application.

There has been much discussion about the provenance of the type of *Agrostis zenkeri.* The type specimen at LE quite clearly bears a label stating that it comes from the Nilgiris in southern India, and Bor (1954) argued convincingly that it was collected by Bernard Schmid and then sent to Zenker. As no further material of this species has been collected from the area, it has been supposed that a mix-up of labels might have occurred (Bor, 1954; Noltie, 1999). However, there is no real evidence for this. Bor also erroneously described the lemma of *A. zenkeri* as 3-nerved; in fact, it is 5-nerved as correctly observed by Hooker (1896: 258). Both *A. zenkeri* and *D. abnormis* have 5-nerved lemmas.

The protologue description of *Calamagrostis srilankensis* Davidse (1994: 107) from montane grassland in Sri Lanka agrees quite well with the description of the type of *Agrostis zenkeri* by Veldkamp. In this species the lemma midnerve is variable, sometimes extending nearly to the lemma tip (as in *A. zenkeri)* and sometimes excurrent from near the base. It has been transferred to *Deyeuxia* by Veldkamp (1996: 410). Unfortunately, there is no isotype specimen of *C. srilankensis* at Kew, although it is said to be present in the protologue. We are not pursuing this further as it is not a Chinese problem, but it seems likely that the type of *A. zenkeri* was indeed collected in southern India, and may even be conspecific with *D. srilankensis.*

Deyeuxia sichuanensis (J. L. Yang) S. M. Phillips & W. L. Chen, comb. nov. Basionym: *Calamagrostis sichuanensis* J. L. Yang, Acta Bot. Yunnan. 5: 47. 1983. TYPE: China. Sichuan: Wenchuan, Wolong, 2850 m, *J. L. Yang 8221* (holotype, SAUT not seen; isotypes, CDBI not seen, PE).

Distribution. China (Gansu, Sichuan).

Deyeuxia sichuanensis has the scabrous lemma, callus hairs only half as long as the lemma, and penicillate rachilla extension of a typical *Deyeuxia*, as nicely shown in the illustration accompanying the protologue (1983: 48). It is similar to *D. nepalensis* Bor, but can be distinguished as follows:

Lemma awned from near middle; awn ca. 1.2 mm, included in spikelet; anthers ca. 1 mm . . . . . *D. sichuanensis*

Lemma awned from near apex; awn 3–6 mm, exserted from spikelet; anthers ca. 2 mm . . . . . *D. nepalensis*

Deyeuxia korotkyi (Litvinov) S. M. Phillips & W. L. Chen, comb. nov. Basionym: *Calamagrostis korotkyi* Litvinov, Schedae Herb. Fl. Ross. 55: no. 2750. 1918. TYPE: *Korotky H.F.R. 2750* (holotype, LE not seen).

Calamagrostis turczaninowii Litvinov, Not. Syst. Herb. Hort. Petrop. 2: 115. 1921. *Calamagrostis korotkyi* subsp. *turkczaninowii* (Litvinov) Tzvelev, Zlaki SSSR: 304. 1976. *Deyeuxia turczaninowii* (Litvinov) Y. L. Chang ex S. L. Lu, Fl. Reipubl. Popularis Sin. 9(3): 205. 1987. TYPE: Russia. Zaibaikal district, 6 Aug. 1909, *I. Blagoveshchenskii & G. Poplavskya 1472* (lectotype, designated by Tzvelev (1976: 304), LE not seen).

Distribution. Mongolia, Russia (E Siberia), China (N Heilongjiang, N Nei Mongol, NW Xinjiang).

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A New Species of *Rothmannia* (Rubiaceae) from Yunnan, China

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ABSTRACT. A new species in Rubiaceae (Gardenieae), *Rothmannia daweishanensis* Y. M. Shui & W. H. Chen, is described from Yunnan, China. Its diagnostic characters and close relationship with *Rothmannia vietnamensis* Tirvengadum are discussed.

Key words: China, *Rothmannia*, Rubiaceae, Yunnan.

During a phytogeographic study in the Daweishan range, southeastern Yunnan, and the revision of Rubiaceae for the *Flora of Yunnan* in 2001, Chen Wei-Chiu found a collection of Rubiaceae in young fruit, *Y. M. Shui & W. H. Chen 12242*, unrecorded for China (Chen, 1999). Later, another collection in both flower and fruit, *Y. M. Shui, C. X. Pu & Z. L. Nie 14496*, confirmed that a new species in Rubiaceae had been discovered.

In accordance with studies of the tribe Gardenieae (Ixoroideae) in southern and southeastern Asia (Tirvengadum, 1983; Robbrecht & Puff, 1986) and Africa (Bridson, 1983, 1988), we place the new species in the genus *Rothmannia* Thunberg, albeit provisionally because of the difficulty of delimitation of the genera of Gardenieae. This is thus the first record of the genus for China and Yunnan. Because this genus is known only from tropical Asia and Africa, its discovery in Yunnan adds weight to the opinion that the flora of the Daweishan range has a tropical element and is allied to the flora of the Paleotropical Region (Wu & Wu, 1998).

Rothmannia occurs in tropical and southern Africa, east into the Seychelles as well as in southern and southeastern Asia, with 63 species recognized as valid in the International Plant Names Index (⟨www.ipni.org⟩). According to Jarvie and Ermayanti (1996), together with Tirvengadum (1983), the diagnostic features of the genus are: shrubs or large trees (generally 4–15 m tall), spines absent; bud terminal and nude; inflorescences terminal, paniculiform; flowers coming from a single point on the stem, or on a branched axis; petals 5, joined together, not fleshy, entire; corolla sometimes large, purple speckled inside the tube; stamens 5, subsessile, not fused, adherent to the perianth, equal in size; styles solitary, with 2-lobed stigmas; carpels connate, 2 (or 3), with 2 (or 3) locules; fruit berry-like, globular or spherical, fleshy, sometimes up to 5–6 cm in diameter; seeds flat, sunk in a pulpy matrix. Some species have been cultivated for horticulture, such as *Rothmannia capensis* Thunberg (⟨nature.jardin.free.fr/arbre/ft_rothmannia.html⟩) and *Rothmannia globosa* (Hochstetter) Keay (⟨www.shop.sunshine-seeds.de/d_11159_Rothmannia_globosa34658.htm⟩).

Rothmannia daweishanensis Y. M. Shui & W. H. Chen, sp. nov. TYPE: China. Yunnan: Maguan County, Gulinqing community, Woody Station nearby Nanxi Community of Hekou County, 22°40′N, 103°53′E, 500–600 m, 20 Nov. 2000 (fl & fr), *Y. M. Shui, C. X. Pu & Z. L. Nie 14496* (holotype, KUN; isotypes, KUN, MO). Figure 1.

Species *Rothmanniae vietnamensi* similis, sed calycis lobis lineari-oblongis, 1.4–1.6 cm longis (nec 0.7 cm) et corollis campanulatis 5–5.5 cm longis (nec tubaeformibus ca. 2.2 cm) differt.

Tree 10–15 m, glabrous throughout; bark lenticellate, gray-shaded; young twigs dichotomous. Leaves: blades chartaceous, ovate, 10–14 × 4–5 cm, attenuate slightly from the middle to narrowly cuneate at the base, slightly decurrent on the petiole, apex distinctly acuminate, tip obtuse, both surfaces green-brown and glossy, midrib shallowly canaliculate at adaxial surface, prominent at abaxial surface, lateral nerves 5 or 6 pairs; secondary nerves faintly visible adaxially, slightly prominent abaxially, almost all in 32–35° angle to the midrib; petiole 0.3 cm long; stipules broadly triangular-ovate, 1.5–2.0 × 2–3 mm, distinct at base, acuminate at apex. Inflorescence uniflorous, protruding

Figure 1. *Rothmannia daweishanensis* Y. M. Shui & W. H. Chen. —A. Habit. —B. Corolla. —C. Calyx lobes and pedicel. —D. Fruit. —E. Transverse section of fruit and seeds. Drawn by Liu Yi-Tao from the holotype (*Y. M. Shui, C. X. Pu & Z. L. Nie 14496*).

from a very reduced branch above a pair of leaves, superficially terminal or axillary; reduced branch ca. 5 mm long; pedicels 2.0–2.5 cm long with 3 bracteoles; bracteoles alternate and triangular, 1.5 × 1.0 mm, glabrous outside, sericeous inside. Calyx lobes linear-oblong, 14–16 × 0.7–0.9 mm, obtuse at apex, 1-nerved, deciduous. Calyx tube 2–2.5 mm long, 5–6 mm diam., sparsely sericeous outside, densely long-pubescent, and with short colleters inside. Corolla campanulate, tubes glabrous, 5–5.5 cm long, 3 cm diam. at mid-point, white outside, striated, and mottled purple inside, abruptly contracted at base into a slender tube 6–7 mm long and 5 mm diam.; corolla lobes 5, glabrous, broadly ovate, 1.8–2.0 × 2.2–2.3 cm, obtuse at apex, white outside, with purple mottling inside, deciduous and not evident on fruit. Stamens 5, alternate to corolla lobes, subsessile, inserted on the upper part of corolla tube; anthers linear, 1.9–2.0 × 0.1 cm, longitudinally dehiscent, tapered to 0.5 mm; ovary parietal, seemingly 2-locular, ovules numerous in each row on placentas, placentas amalgamating at the center of the ovary. Style 5 cm long, stigmatic surface up to 2.0 cm long, ca. 0.1 cm diam., oblong-lanceolate. Fruit elongate when young, ca. 3.5 × 1.6 cm, spherical at maturity, ca. 4–5 cm diam., slightly inflated and decurrent at base. Seeds numerous, lenticular, 1.2 cm long, 0.8 cm wide, 0.4 cm thick, sunk in a pulpy matrix.

Habitat and distribution. Among the rocky crevices in the limestone rainy forests, 300–600 m; known only from Yunnan, China.

Phenology. Flowering from October to December; fruiting from December throughout the following year until the next March.

Etymology. Rothmannia daweishanensis is named after the Daweishan mountain range located in southeastern Yunnan, which is one of the richest floras noted for Yunnan as well as China (Shui, 2000).

Although it is difficult to delimit the genera of Gardeniaceae, the solitary flower, slightly lobate corolla tubes to 5–5.5 cm long, as well as the obovoid or obovoid-oblong fruits, are all similar to the characters noted for *Rothmannia* (Tirvengadum, 1983). Within this genus, *Rothmannia daweishanensis* is similar to *Rothmannia vietnamensis* Tirvengadum in the shape of the fruits, but the latter differs mainly in its wider, broadly triangular calyx lobes to 0.7 cm and in its shorter corolla tubes to only 2.2 cm long.

Paratypes. CHINA. **SE Yunnan:** Maguan County, Gulinqing, Arboretum-examining Station, in tropical seasonal rainy forest, 2 Oct. 2002, *Y. M. Shui, W. H. Chen & J. S. Sheng 30098* (KUN, PE); Maguan, Gulinqing, Xintian-cun, alt. 500–600 m, in subtropical montane forest of limestone area, 18 Aug. 1994, *S. K. Wu, X. Cheng, Y. P. Yang, J. Murata, T. Sugawara, T. Kawahara & H. Nagamasu* 2524 (KUN); Hekou County, Nanxi, Huayudong National Forestry Park, 300 m, 22 Apr. 2000, *Y. M. Shui & W. H. Chen 12242* (KUN); Nanxi, 24 Nov. 1982, *S. Q. Xiao & P. X. He 3222* (SWFC).

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Mostuea muricata (Gelsemiaceae), a New Species from Brazil

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Abstract. *Mostuea muricata*, an American species from a predominantly African genus, is described, illustrated, and compared with the African *M. brunonis* and the American *M. surinamensis*, from which it is distinguished mainly by its muricate fruits and rugose, glabrous, and viscose seeds. This species was collected in the Brazilian states of Mato Grosso and São Paulo, and its finding represents a southward extension of the range of *Mostuea* in South America, before now known only in Suriname and northern Brazil.

Resumen. Se describe y ilustra *Mostuea muricata*, una especie americana de un género principalmente africano. Se la compara con la especie africana *M. brunonis* y con la especie americana *M. surinamensis*, de las cuales se diferencia especialmente por sus frutos muricados y sus semillas rugosas, glabras y viscosas. Esta especie fue colectada en los estados brasileños de Mato Grosso y São Paulo, y su hallazgo representa una extensión austral del área geográfica del género en Sudamérica, que hasta ahora se conocía sólo en Surinam y el norte de Brasil.

Key words: Brazil, Gelsemiaceae, *Mostuea*.

Mostuea Didrichsen is a small genus with eight recognized species (Leeuwenberg, 1961), seven in Africa and one disjunct in northern South America. It was formerly included in the Loganiaceae, together with *Gelsemium*, in the tribe Gelsemieae (Leeuwenberg, 1961); nevertheless, recent phylogenetic studies (Struwe et al., 1994; APG, 1998; Backlund et al., 2000) strongly support the recognition of tribe Gelsemieae as a separate family, Gelsemiaceae, mainly characterized by heterostylous flowers with twice-divided stigmas, latrorse anthers, imbricated corolla aestivation, and flattened seeds (Struwe et al., 1994). In this paper we describe a second South American species, collected in the Brazilian states of São Paulo and Mato Grosso.

Mostuea muricata Sobral & Lc. Rossi, sp. nov. TYPE: Brazil. São Paulo: São Carlos, Santa Eudóxia, Nov. 1993, *M. Sobral & J. R. Stehmann 8049* (holotype, SP; isotypes, ICN, MBM, MO). Figures 1, 2.

Species haec *M. brunoni* et *M. surinamensi* proxima, a quibus fructibus muricatis, seminibus viscosis recedit.

Undershrub to shrub 0.5–1.5(2) m high. Branches dichotomous, sparsely to densely whitish-tomentose with hairs 0.1–0.2 mm long, eventually in unequally developed pairs, always with 2 pairs of leaves and bearing flowers, with 2 callose, elliptic, and somewhat paler protuberances 1.5–2.0 mm long by the insertion of the petioles. Leaves discolored in dried specimens, ovate, obovate, or elliptic-obovate, the proximal ones strongly unequal in size, (3)10–40 × (2)5–25 mm, smaller than the distal ones, these equal or subequal in size, asymmetrical, 30–75 × 17–40 mm, with pale hairs 0.1–0.2 mm scattered adaxially and more dense and velutinous abaxially, especially on nerves; apex acute; base cuneate or rounded, frequently cordate and then with the lobes concealing adaxial petioles; central and secondary nerves sulcate adaxially and salient abaxially, the secondary nerves 6 to 8(10) pairs; petioles 1.0–1.5(2) × 1.0–1.3 mm, scarcely visible from the adaxial side; stipules interpetiolar triangular, 1.0–1.2 × 1.2–1.5 mm, 1- to 5-laciniate, the laciniae 0.8–1.0 × 0.2 mm; colleters linear, up to 10 × 1 mm, inside the stipules. Inflorescences terminal dichasia or dichotomous cymes, smaller than the leaves, 3- to 20-florous, rarely uniflorous; peduncles 10–20 mm long; bracteoles linear, 1–3 × 0.1 mm. Flowers heterostylous, pentamerous, rarely tetramerous; pedicels absent or to 3 × 0.2 mm; calyx 1.7–2.0 mm long, sparsely to densely covered with hairs, with equal or slightly unequal laciniae 1–2 × 0.3–0.8 mm; corolla infundibuliform, white, glabrous or scarcely pilose externally at the apex, 5.5–8.0 × 2.0–2.5 mm in the widest

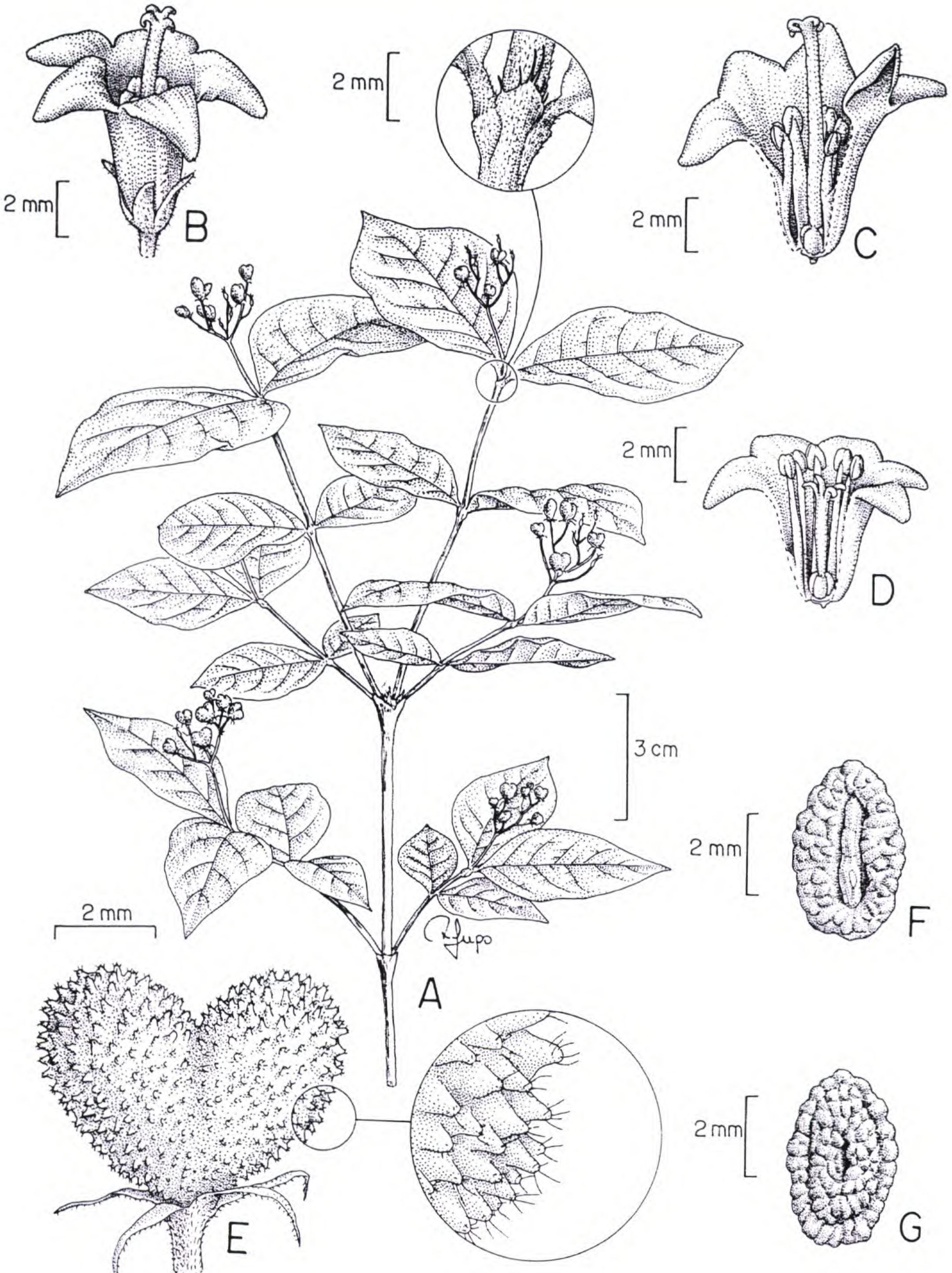

Figure 1. *Mostuea muricata* Sobral & Lc. Rossi. —A. Fruiting branch. —B. Longistylous flower. —C. Longistylous flower in longitudinal section, drawn from fresh material showing recurved corolla lobes. —D. Brevistylous flower in longitudinal section. —E. Fruit. —F. Seed, adaxial view. —G. Seed, abaxial view. A, E–G: *Jaccoud 20*; B, C: *Rossi et al. 1700*; D: *Rossi et al. 1697*.

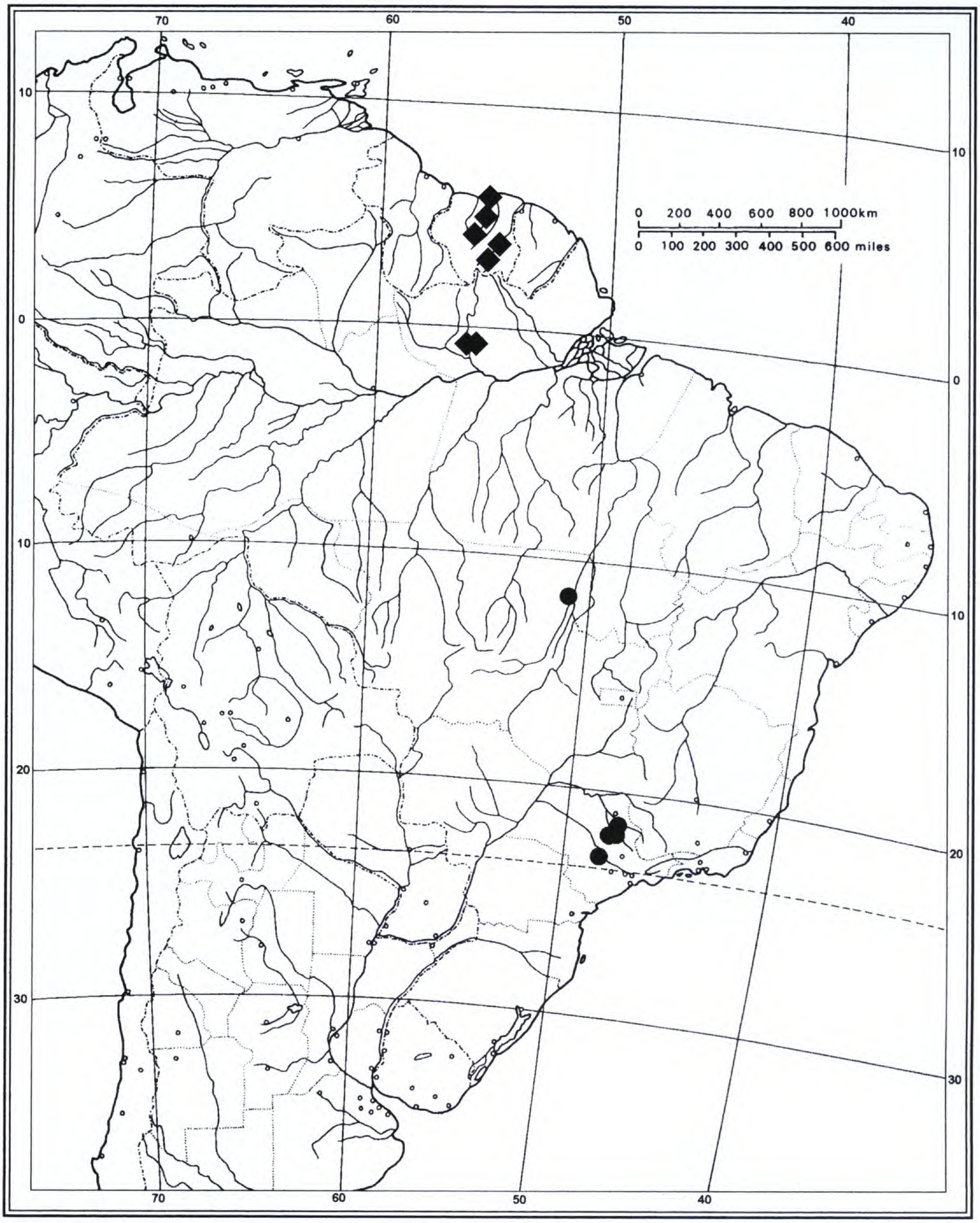

Figure 2. Distribution of collections of *Mostuea muricata* (circles) and *M. surinamensis* (polygons). Collections in Suriname are marked after Leeuwenberg (1961), and Brazilian collections (*Cid et al. 2055, 2300* (MO), *Ducke s.n.* (RB), and *Sampaio 5094*, (R)) were examined.

portion, the lobes 1.5–2.5 × 1.5–2.0 mm, occasionally slightly revolute in nature; stamens equal in size, 5–7 mm long and with exserted anthers in brevistylous flowers, included and somewhat unequal ca. 4 mm long in the longistylous flowers; styles twice-branched, included and ca. 4 mm long in brevistylous flowers and ca. 6 mm long and exserted in longistylous ones; ovary 1.8–2.0 × 1.5–1.8 mm, externally 4-lobed, sometimes slightly verrucose, glabrous or with scattered white hairs about

0.1 mm long at the apex, bilocular with 2 ovules with central-basal placentation by locule. Fruit an obcordate capsule, 5–6 × 7–10 mm, strongly muricate, with excrescences 0.1–0.3(0.5) mm long crowned with a tuft of 4 to 5 pale hairs about 0.1 mm long. Seeds 2 to 4, red, shining, and viscose when fresh, plano-convex, ellipsoid, glabrous, rugose, with a visible raphe and hylum in the flattened face, 4.5–5.0 × 3.5 mm.

Vernacular name. Agarra-agarra (from *Jaccoud 20*). "Agarra" is the Portuguese word for "grasp," and it is probable that the name has derived from the ability of the seeds to attach to clothes or skin.

Distribution, habitat, and phenology. Disjunct African and American families and genera are relatively common (Gentry (1993) listed 118 genera in 51 families). *Mostuea* is an example of such a phenomenon, with seven of its eight recognized species (Leeuwenberg, 1961) occurring in Africa and one in South America. The discovery of a species of *Mostuea* in central and southeastern Brazil expands southward the geographical distribution of the genus in South America. As far as known, the distribution of the two American species does not overlap (*M. surinamensis* Bentham is recorded only for Suriname and northern Brazil), and in overall morphology they look less similar to each other than *M. muricata* to the African *M. brunonis* Didrichsen (see Affinities below). Thus, *Mostuea* as presently defined (Leeuwenberg, 1961) comprises nine species, seven in Africa and two in South America. *Mostuea muricata* grows in shady and sandy sites in the interior of mesophyllous forests ("cerradões"), where it eventually occurs in great densities in the understory. Flowers were collected from September to January, and fruits from October to February.

Affinities. *Mostuea muricata* appears related to African *M. brunonis* and American *M. surinamensis* (for descriptions see Leeuwenberg, 1961) but is markedly set apart from both by fruit and seed morphology. The fruits in *M. brunonis* are smooth, glabrous or appressed-pubescent, and the seeds minutely reticulate, dull and densely appressed-pilose; fruits in *M. surinamensis* are smooth, glabrous, deeply bilobed (2 to 4 times as wide as long vs. lobes at most as wide as long in all other species), and seeds are glabrous and shiny, apparently not viscose. Vegetatively, *M. muricata* may be hard to distinguish from *M. brunonis*; this highly variable and widespread species (from Ghana to Madagascar; Leeuwenberg, 1961) has a wide range of leaf variation in size (6–280 × 3–125 mm) and shape (orbicular to oblong-ovate or lanceolate); from *M. surinamensis* it can be separated by the elliptic to oblong-elliptic leaves in this species. We have also observed that in *M. muricata* all branches have a limited size, bear four leaves, and end in an inflorescence—that is, apparently there are no vegetative branches, while they may be found in the other two species; nevertheless, it would be premature to take it as a diagnostic feature.

Paratypes. BRAZIL. **Mato Grosso:** São Félix do Araguaia, beira do rio Araguaia, 11°38′11.7″S, 50°40′23.7″W, 17 Mar. 1997, *Souza et al. 14231* (ESA, SP). **São Paulo:** Anhembi, mata da fazenda Barreiro Rico, 5 Oct. 1956, *Kuhlmann 3971* (RB, SP); Descalvado, Fazenda Graciosa, 3 Feb. 1966, *Bordo 58* (SP); estrada em direção a Santa Eudóxia, 8 Nov. 1995, *Rossi et al. 1696, 1697* (SP), *Rossi et al. 1700* (SP); Fazenda Jaguarão, Nov. 1993, *Sobral & Stehmann 8045* (ICN, MBM, SP), *8046* (ICN, SP), *8047* (ICN, MBM, SP), *8048* (ICN, SP), 21 Jan. 1997, *Stehmann & Sobral 2234* (BHCB, ICN); São Carlos, Santa Eudóxia, próximo à Fazenda Figueira Branca, 30 Sep. 1980, *Semir et al. 11540* (UEC), *11541* (UEC); São Simão, Bocaina, próximo ao córrego da Prata, 8 July 1961, *Jaccoud 20* (RB, SP), 30 Nov. 1960, *Kuhlmann 5004* (SP); Fazenda Bocaina, 29 Nov. 1961, *Mattos 8674* (RB, SP).

Acknowledgments. We thank João R. Stehmann, Eloísa de Araújo Rodrigues, and Maria Lúcia Kawasaki for their kind help during the collections of *Mostuea muricata*, the curators of BR, ESA, MO, SP, and UEC, and Rogério Lupo, for the beautiful drawing of the species.

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New Combinations in *Rohdea* (Convallariaceae)

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ABSTRACT. Comparative survey shows that *Rohdea* differs from eight species of *Tupistra*, one species of *Campylandra* (*C. aurantiaca*), and one species of *Gonioscypha* (*G. eucomoides*) mainly by the degree of thickness of the perianth and in the shape and length of the perianth lobes. As these differences do not seem to deserve generic delimitation, those species of the last three genera are here transferred to *Rohdea*. As a consequence, the following 10 new combinations are proposed: *Rohdea aurantiaca* (Baker) N. Tanaka, *Rohdea chinensis* (Baker) N. Tanaka, *Rohdea delavayi* (Franchet) N. Tanaka, *Rohdea emeiensis* (Z. Y. Zhu) N. Tanaka, *Rohdea ensifolia* (F. T. Wang & Ts. Tang) N. Tanaka, *Rohdea eucomoides* (Baker) N. Tanaka, *Rohdea jinshanensis* (Z. L. Yang & X. G. Luo) N. Tanaka, *Rohdea longipedunculata* (F. T. Wang & S. Yun Liang) N. Tanaka, *Rohdea tonkinensis* (Baillon) N. Tanaka, and *Rohdea verruculosa* (Q. H. Chen) N. Tanaka.

Key words: *Campylandra*, Eastern Asia, *Gonioscypha*, *Rohdea*, *Tupistra*.

The genus *Rohdea* was first described by Roth (1821) with *R. japonica* (Thunberg) Roth from Japan. Later, five other specific names were originally published in the genus (cf. Liang, 1978; Liang & Tamura, 2000). Recent studies by Liang (1978) and Liang and Tamura (2000) recognized only one species, *R. japonica* (Fig. 1), in this genus. The five other names were either submerged in *R. japonica* or treated in other related genera (*Tupistra*, *Campylandra*). In reviewing the generic circumscription of *Rohdea*, a comparison with its allied genera *Tupistra*, *Campylandra*, and *Gonioscypha* is inevitable. *Tupistra* was described by Ker Gawler (1814) with *T. squalida* from Ambon (Amboyna), Indonesia, though its provenance is questioned (Jessop, 1979). *Campylandra* was founded by Baker (1875) with the Himalayan species *C. aurantiaca* Baker. *Tupistra* and *Campylandra* were regarded as distinct by some botanists (e.g., Baker, 1875; Engler, 1888; Hutchinson, 1934; Tamura et al., 2000), while *Campylandra* was treated as congeneric with *Tupistra* by others (e.g., Bentham, 1883; Hooker, 1892; Baillon, 1894; Liang, 1978; Huang & Li, 1990). Under the latter view, many species with the features of *Campylandra* were described as *Tupistra* (cf. Liang & Tamura, 2000; Tamura et al., 2000). All or many of the species of *Tupistra* dealt with in many papers (e.g., Liang, 1978; Huang et al., 1989, 1990; Ma & Hong, 1990; Yang & Zhu, 1990; Huang & Hong, 1997; Li, 1997) are those corresponding with *Campylandra*.

Huang and Li (1990) subdivided *Tupistra* into two subgenera, subg. *Tupistra* and subg. *Campylandra*, the former comprising 13 species and the latter 14. Regarding *Campylandra* as a distinct genus, Tamura et al. (2000) transferred 12 species initially described under *Tupistra* and 2 species of *Rohdea* to it. Liang and Tamura (2000) recognized 16 species in all in *Campylandra*. Yamashita and Tamura (2001) recently added 1 new species to *Campylandra*, bringing the total to 17. I agree with these botanists in regarding *Campylandra* as generically distinct from *Tupistra*. *Campylandra* differs from *Tupistra* in having small trisected stigmas (Fig. 2A, C) (vs. usually moderately to largely peltate, fungilliform, or trilobed stigmas), orange to scarlet smooth pericarps (Liang, 1978; Li, 1997) (vs. dark, somewhat purplish brown to almost black, often muricate or warty pericarps) (cf. Wan, 1984; my own observations on *T. albiflora* K. Larsen and *T. fungilliformis* F. T. Wang & S. Yun Liang, of which the specimens are cited below), unimodal karyotypes (vs. bimodal karyotypes) (Huang et al., 1989, 1990; Yang & Zhu, 1990; Yang, 1995; Huang & Liu, 1996), and monosulcate ellipsoidal pollen (vs. inaperturate spheroidal pollen) (Ma & Hong, 1990; Huang & Hong, 1997).

Meanwhile, *Campylandra* was treated as distinct from *Rohdea* by many botanists (e.g., Baker, 1875; Bentham, 1883; Engler, 1888; Hutchinson, 1934; Conran & Tamura, 1998; Liang & Tamura, 2000). According to Baker (1875), *Campylandra* differs from *Rohdea* in having an elongate style (vs. almost lacking), short filaments (vs. none), and anthers located beneath the throat of the perianth tube (vs. at the throat of the tube). According to current knowledge, however, these distinctions are insignificant or partially incorrect. An indistinct style is

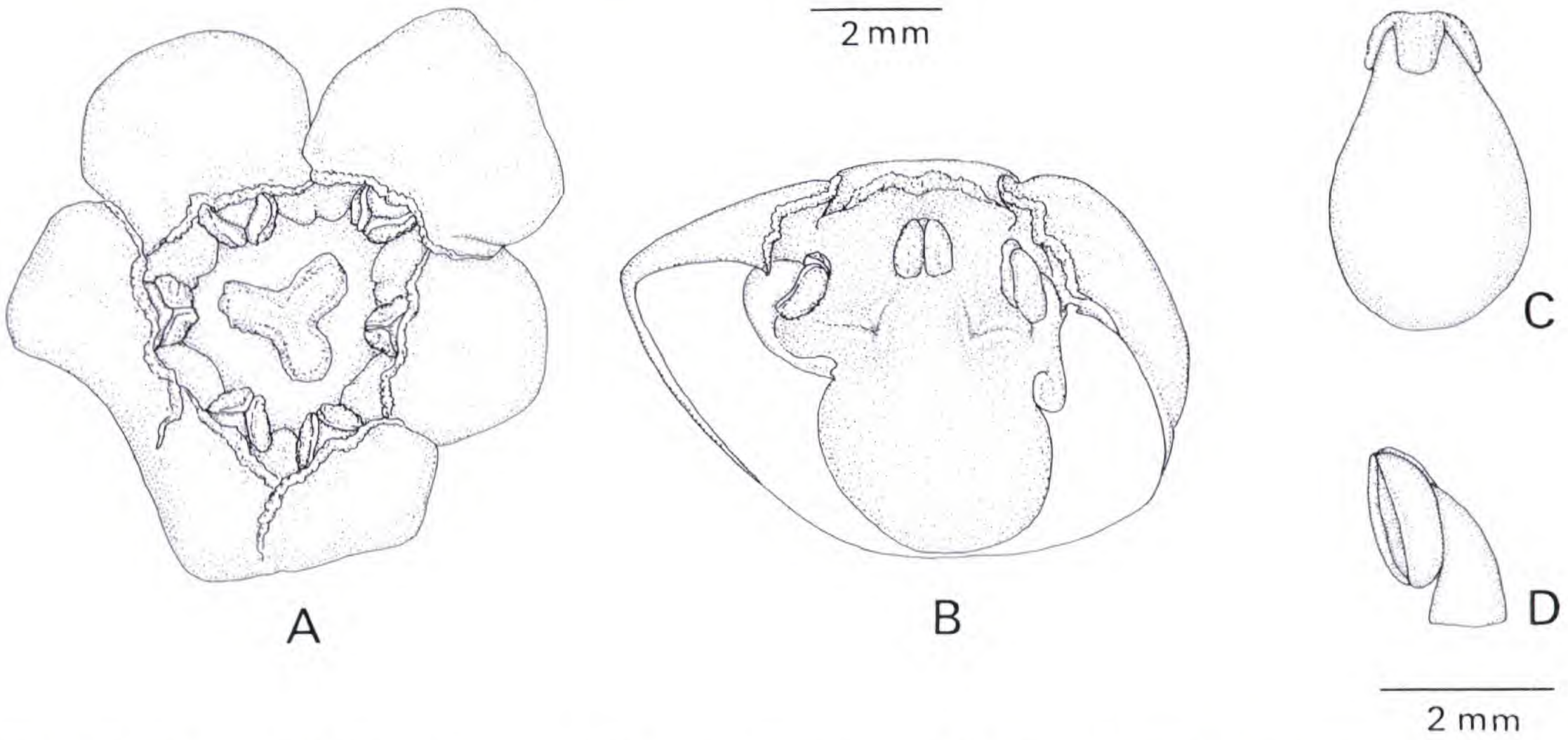

Figure 1. Flower of *Rohdea japonica*.—A. Flower in front view. —B. Flower longitudinally sectioned with pistil removed. —C. Pistil in longitudinal view. —D. Stamen in longitudinal view. A–C to same upper scale, D to lower scale. Drawn by Noriyuki Tanaka from a living plant in cultivation (*N. Tanaka s.n.*, TEU).

also seen in some species of *Campylandra*, such as *C. siamensis* Yamashita & M. N. Tamura, *C. verruculosa* (Q. H. Chen) M. N. Tamura, S. Yun Liang & Turland, and *C. kwangtungensis* Dandy. Anthers are located at or near the throat of the tube in *C. urotepala* (Handel-Mazzetti) M. N. Tamura, S. Yun Liang & Turland, and *C. longipedunculata* (F. T. Wang & S. Yun Liang) M. N. Tamura, S. Yun Liang & Turland (Fig. 2A, B). In *Rohdea japonica*, contrary to Baker's statement, filaments are evidently present, though short, as shown in Figure 1 (A, B, and D).

Conran and Tamura (1998) reported that *Campylandra* has one stigma while *Rohdea* has three. In my examination, both genera share a trisected stigma in common (Figs. 1A, C, 2A, C). According to Chen et al. (2000), *Rohdea* differs from *Campylandra* by its inflexed, very short perianth lobes (vs. spreading to incurved lobes, which are 1/3–1/2 as long as the tube). In their diagnosis the term "inflexed" may be used to express a more abrupt or angulated incurvature than "incurved." *Rohdea* certainly has comparatively short perianth lobes (Fig. 1A, B), but as to their curvature, it cannot simply be said, at least at the flowering peak, that the lobes are inflexed. The perianth of *R. japonica* is incrassate (Fig. 1A, B), and the lobes are, on the ventral side, incurved to nearly erect (Fig. 1B), and on the dorsal side incurved to strongly inflexed (Fig. 1A, B). In *Campylandra*, many species (e.g., *C. longipedunculata* and *C. verruculosa*) also have perianth lobes showing incurvature at least in their

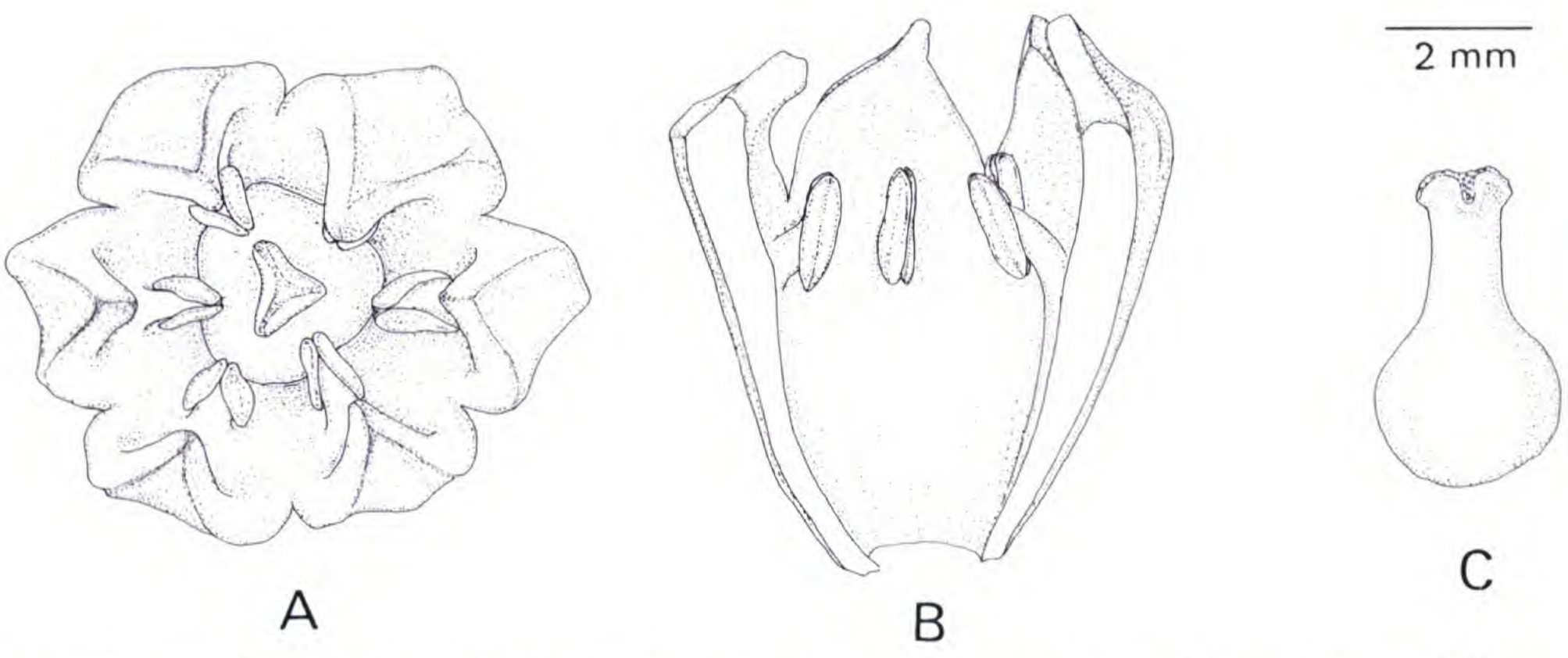

Figure 2. Flower of *Rohdea longipedunculata* (*Campylandra longipedunculata*). —A. Front view. —B. Longitudinal section with pistil removed. —C. Pistil in longitudinal view. A–C to same scale. Drawn by Noriyuki Tanaka from a living plant in cultivation, which was raised from a seed of *H. Li, N. Tanaka & T. J. Xiao 356* (TEU).

upper part (Fig. 2A, B). The degree of incurvature of the perianth lobes seems, therefore, not to be decisive for distinguishing the two genera.

In my observation, *Rohdea* (*R. japonica*) differs from *Campylandra* mainly by the following features: (1) the perianth lobes are short (vs. moderately long) and truncate or subtruncate (vs. round to acuminate) at the apex, and (2) the perianth is very incrassate with the lobes (usually upper ones) particularly thickened dorsally (vs. less incrassate and less dorsally thickened) (Figs. 1A, B, 2A, B). These differences, however, seem to be insufficient for the purpose of generic separation. Among others, the second difference appears to be rather quantitative. Besides the close similarity in various organs or parts of the plants (e.g., basal two-ranked foliage leaves, flowers in a compact spike, fleshy usually greenish or yellowish perianths, small trisected stigmas, and orange to scarlet smooth pericarps), the two genera share similar unimodal karyotypes with the basic chromosome number $x = 19$ (Yang & Zhu, 1990), and monosulcate, ellipsoidal pollen with a perforate or reticulate exine (Ma & Hong, 1990; Huang & Hong, 1997). Their close affinity is also supported from an analysis of DNA sequences of the *trn*K and *rbc*L regions of the chloroplast (Yamashita & Tamura, 2000).

The genus *Gonioscypha* was established by Baker (1875) with *G. eucomoides* Baker from Bhutan, eastern Himalaya. According to him, this species is characterized by petiolate leaves, oblong cylindric perianth tubes, and long styles with a small capitate stigma. All these characters are, however, not significantly distinct from *Campylandra*. The capitate stigma of *Gonioscypha* is, in fact, trisected (*Kingdon-Ward 12470*, BM; *Lister 132*, K) as illustrated in plate 19 of Baker (1875) and figure 32 of Hutchinson (1934), and this feature is consistent with the stigmas of both *Campylandra* and *Rohdea*. *Campylandra delavayi* (Franchet) M. N. Tamura, S. Yun Liang & Turland and *C. fimbriata* (Handel-Mazzetti) M. N. Tamura, S. Yun Liang & Turland often have relatively broad leaf blades narrowing into a petiole, cylindric perianth tubes, and relatively long styles, approaching the features of *G. eucomoides*. The perianth lobes of *Gonioscypha* tend to be slightly excurved below the middle (*Kingdon-Ward 12470*, BM; *Lister 132*, K). The perianth lobes of some species of *Campylandra* are also excurved or spreading at least in the lower part (e.g., *C. chinensis* (Baker) M. N. Tamura, S. Yun Liang & Turland; *C. delavayi*; *C. emeiensis* (Z. Y. Zhu) M. N. Tamura, S. Yun Liang & Turland; *C. urotepala*; *C. yunnanensis* (F. T. Wang & S. Yun Liang) M. N. Tamura, S. Yun Liang & Turland). *Gonioscypha eucomoides* can no doubt be included in *Campylandra*, and the latter is also referable to *Rohdea*, as stated above.

In *Gonioscypha* there is another species, *G. muricata* Gagnepain, described from Laos (Gagnepain, 1934). This species has pistils surpassing the stamens, small but discoid stigmas, muricate pericarps, long somewhat lax spikes, and long slender petioles (*Thorel 3314*, P). These features are coincident with some or many species of *Tupistra*, and therefore *G. muricata* is excluded from the treatment of this paper.

From the reasons stated above, nine species of *Campylandra* (cf. Liang & Tamura, 2000; Tamura et al., 2000), of which eight were originally published under *Tupistra*, and *Gonioscypha eucomoides* are transferred here to *Rohdea*.

A more detailed account of the genus *Rohdea*, including a key to the species and synonymy, is planned by the author to be published elsewhere.

Rohdea aurantiaca (Baker) N. Tanaka, comb. nov. Basionym: *Campylandra aurantiaca* Baker, J. Linn. Soc., Bot. 14: 582. 1875. *Tupistra aurantiaca* (Baker) Wallich ex Hooker f., Fl. Brit. Ind. 6: 325. 1892. TYPE: India. East Himalaya, Darjiling, *W. Griffith 5886* (lectotype, designated here, K).

Other selected specimens examined. NEPAL. [Without locality] *N. Wallich s.n.* (types, BM, E). SIKKIM. [Without locality] 4000–6000 ped. [ft.], *J. H. Hooker s.n.* (type, GH). INDIA. **Arunachal Pradesh**: East Bengal, Mishimi. *W. Griffith 5888* (type, K).

Rohdea chinensis (Baker) N. Tanaka, comb. nov. Basionym: *Tupistra chinensis* Baker, in Hooker, Icon. Pl. 19: t. 1867. 1889. *Campylandra chinensis* (Baker) M. N. Tamura, S. Yun Liang & Turland, Novon 10: 159. 2000. TYPE: China. [Hubei]: Patung [Badong] district, *A. Henry 5023* (holotype, K photo).

Other selected specimens examined. CHINA. **Hubei**: Xingshan (Wanchaoshan), 1700 m, 8 May 1982, *Z. D. Jiang & G. F. Tao 198* (A). **Szechwan [Sichuan]**: Nanchuan Hsien, 7000–8000 ft., 26 May 1928, *W. P. Fang 946* (GH).

Rohdea delavayi (Franchet) N. Tanaka, comb. nov. Basionym: *Tupistra delavayi* Franchet, Bull. Soc. Bot. France 43: 40. 1896. *Campylandra delavayi* (Franchet) M. N. Tamura, S. Yun Liang & Turland, Novon 10: 159. 2000. TYPE: China. Hupeh [Hubei]: Ichang, Mar. 1889, *A. Henry 5231A* (lectotype, designated here, P; isotype, E).

Other selected specimen examined. CHINA. **Yunnan**: "les bois à Outchay, près de Ta kouen," 19 Mai 1882, *A. P. J. M. Delavay* (type, P).

Rohdea emeiensis (Z. Y. Zhu) N. Tanaka, comb. nov. Basionym: *Tupistra emeiensis* Z. Y. Zhu, Acta Bot. Yunnan. 4: 271. 1982. *Campylandra emeiensis* (Z. Y. Zhu) M. N. Tamura, S. Yun Liang & Turland, Novon 10: 159. 2000. TYPE: China. Sichuan: Emeishan, 1800–2500 m, 1 June 1976, *D. Q. Li & Z. Y. Zhu 29* (holotype, EMA not seen).

No specimen seen.

Rohdea ensifolia (F. T. Wang & Ts. Tang) N. Tanaka, comb. nov. Basionym: *Tupistra ensifolia* F. T. Wang & Ts. Tang, Bull. Fan Mem. Inst. Biol. 7: 86. 1936. *Campylandra ensifolia* (F. T. Wang & Ts. Tang) M. N. Tamura, S. Yun Liang & Turland, Novon 10: 159. 2000. TYPE: China. Yunnan: Tengyueh, 6–7000 ft., June 1912, *G. Forrest 8455* (lectotype, designated by Tamura et al. (2000), K photo; isotype, E).

Other selected specimens examined. CHINA. **Yunnan**: Shunning, Hila, 2300 m, 26 June 1938, *T. T. Yü 16479* (A, E).

Rohdea eucomoides (Baker) N. Tanaka, comb. nov. Basionym: *Gonioscypha eucomoides* Baker, J. Linn. Soc., Bot. 14: 581. 1875. TYPE: Bootan [Bhutan]. Aka or Daphla Hills, 2 Nov. 1850, *T. J. Booth s.n.* (holotype, K photo).

Other selected specimens examined. INDIA. **Assam**: Jamiri, Balipara Frontier Tract, 4000–5000 ft., 1935, *F. Kingdon-Ward 12470* (BM). [**Arunachal Pradesh**]: Duphla Hills, 4500 ft., 28 Dec. 1874, *J. L. Lister 132* (K).

Rohdea jinshanensis (Z. L. Yang & X. G. Luo) N. Tanaka, comb. nov. Basionym: *Tupistra jinshanensis* Z. L. Yang & X. G. Luo, Acta Bot. Yunnan. 6: 389. 1984. *Campylandra jinshanensis* (Z. L. Yang & X. G. Luo) M. N. Tamura, S. Yun Liang & Turland, Novon 10: 159. 2000. TYPE: China. Sichuan: Omei (cult. in Sichuan School of Chinese Materia Medica), 450 m, 12 Apr. 1983, *X. G. Luo & Z. L. Yang 483053* (holotype, EMA not seen).

No specimen seen.

Rohdea longipedunculata (F. T. Wang & S. Yun Liang) N. Tanaka, comb. nov. Basionym: *Tupistra longipedunculata* F. T. Wang & S. Yun Liang, in F. T. Wang & Ts. Tang, Fl. Reipubl. Popularis Sin. 15: 249. 1978. *Campylandra longipedunculata* (F. T. Wang & S. Yun Liang) M. N. Tamura, S. Yun Liang & Turland, Novon 10: 160. 2000. TYPE: China. Yunnan: Tsinhung, Cheli, Sheau-meng-yeang, 960 m, Sep. 1936, *C. W. Wang 75985* (holotype, PE; isotype, IBSC).

Other selected specimens examined. CHINA. **Yunnan**: Tsang-Yuan, 1400 m, Apr. 1936, *C. W. Wang 73338* (A); Keng-Ma, 1620 m, Apr. 1936, *C. W. Wang 72934* (A); original locality unknown, cultivated in Kunming Inst. Bot., 5 Nov. 1992, *H. Li, N. Tanaka & T. J. Xiao 356* (TEU).

Rohdea tonkinensis (Baillon) N. Tanaka, comb. nov. Basionym: *Tupistra tonkinensis* Baillon, Bull. Soc. Linn. Paris 2: 1116. 1893. TYPE: [Vietnam]. Tonkin. Vallée de Lankok, Mont Bavi, July 1887, *B. Balansa 4142* (holotype, P).

Other selected specimen examined. CHINA. **Yunnan**: Marlipo, Tung-ting, 1000–1200 m, 18 Nov. 1947, *K. M. Feng 13384* (A).

Liang and Tamura (2000) treated this species (under the name *Tupistra tonkinensis*) as a synonym of *Campylandra wattii* C. B. Clarke. However, so far as I can ascertain, scaly leaves on the stem of *Rohdea tonkinensis* are consistently absent except those at the base of the scape, which is terminally borne on the stem. This feature seems to distinguish *R. tonkinensis* from all other species of the genus.

Rohdea verruculosa (Q. H. Chen) N. Tanaka, comb. nov. Basionym: *Tupistra verruculosa* Q. H. Chen, Acta Phytotax. Sin. 25: 69. 1987. *Campylandra verruculosa* (Q. H. Chen) M. N. Tamura, S. Yun Liang & Turland, Novon 10: 160. 2000. TYPE: China. Guizhou: Pingtang, Bairu, 700 m, 13 May 1982, *Q. H. Chen & J. D. Liu 1328* (holotype, HGAS not seen).

Specimens examined. CHINA. **Kouy-Tcheou** [**Guizhou**]: "bois de Lhon-ly [spelling uncertain]," 2 Avr. 1911, *J. Esquirol 2623* (K, P).

Specimens of other species mentioned in this paper. **Gonioscypha muricata**: LAOS. Pak-lay, 1866–1868, *C. Thorel 3314* (holotype, P). **Rohdea japonica**: JAPAN. **Tôkyô-to**: Tama-shi, 16 Dec. 1993, cult. in Teikyo Univ., 1 June 1997, *N. Tanaka s.n.* (TEU). **Tupistra albiflora**: THAILAND. Mae Tamang, 900 m, 1984, *T. Yahara s.n.*, cult. in Bot. Gard., Univ. of Tokyo, then cult. in Teikyo Univ., 10 Dec. 1995, *N. Tanaka s.n.* (TEU). **Tup-**

istra fungilliformis: CHINA. **Yunnan**: Malipo, Mt. Laojunshan, without record of collector and date, cult. in Kunming Inst. Bot., 25 Oct. 1992, *H. Li, N. Tanaka & T. J. Xiao 23* (TEU).

Acknowledgments. I am most grateful to the directors and curators of A, BM, E, GH, IBSC, K, P, and PE for their loans of the cited material. I also express my cordial thanks to Tetsukazu Yahara (Kyushu University), Jin Murata and Fumio Shimozono (Botanical Garden, University of Tokyo) for providing a species of *Tupistra* from Thailand, to Li Heng and Xiao Tiao-jiang (Kunming Institute of Botany) for cooperation in collecting the material in Yunnan, China, and to Victoria C. Hollowell (Missouri Botanical Garden) and two anonymous reviewers for their critical comments on the manuscript. My thanks are also due to Katsuhiko Kondo (Hiroshima University) for his arrangement of my visit to Yunnan in 1992, which was financially aided by the Ministry of Education, Culture, Sports, Science and Technology of Japan (No. 03044103).

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Inclusion of *Tricalistra* and *Gonioscypha muricata* in *Tupistra* (Convallariaceae)

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ABSTRACT. *Tricalistra*, a monotypic genus comprising *T. ochracea*, and *Gonioscypha muricata* were found not to differ markedly from *Tupistra*. They share many essentially similar characteristics in both vegetative and reproductive organs. *Tricalistra* and *G. muricata* are therefore included in *Tupistra* as *Tupistra ochracea* (Ridley) N. Tanaka and *T. muricata* (Gagnepain) N. Tanaka, respectively.

Key words: Convallariaceae, *Gonioscypha*, Southeast Asia, *Tricalistra*, *Tupistra*.

The genus *Tricalistra* was originally described by Ridley (1909) with the single species *T. ochracea* Ridley from the Malay Peninsula. According to Ridley (1909, 1924), the genus differs from its closest congener, *Tupistra* Ker Gawler, known mainly from Southeast Asia, in the absence of any style (vs. one style) and by the trilobed (vs. discoid or clubbed) stigma being sessile on the truncate top of the short ovary. Jessop (1979) also distinguished the two genera by their styles and stigmas; in *Tricalistra* the style is absent and the stigmas are distinctly 3, while in *Tupistra* the style is distinct and the stigma is simple or indistinctly lobed. Conran and Tamura (1998) regarded *Tricalistra* as differing from *Tupistra* by the absence of the style (vs. long style) and in the hippocrepiform stigma (vs. peltate to fungilliform stigma). All these authors were consistent in regarding the style of *Tricalistra* as absent.

A pistil as well as other floral parts of *Tricalistra ochracea* are illustrated in Figure 1 (A–D). As shown there, the pistil of this species is columnar (Fig. 1B). The ovary (Fig. 1B, ov) is short (ca. 0.6–0.8 mm long) and confined only to the basal portion of the pistil (4–5 mm long). The style (Fig. 1B, sl) is incrassate and long, occupying most of the pistil, and is scarcely differentiated externally from the ovary part. The stigma (Fig. 1B, st; 1C) is nearly as broad as or slightly broader than the style and ovary. Not being attenuate, the style may appear to be absent, as the previous authors reported (see above), but it is apparently present at closer examination. The pistils of *Tupistra* are also more or less columnar with an incrassate long style (Hooker, 1831; Kunth, 1850), being basically similar to those of *Tricalistra*. The stigma of *Tricalistra* is certainly trilobed, as Ridley (1909, 1924) reported, and the lobes are orbicular to ovate or hippocrepiform (Fig. 1B, st; 1C). Trilobed stigmas are, however, also found in some species of *Tupistra*; e.g., *T. albiflora* K. Larsen from Thailand, *T. squalida* Ker Gawler (Ker Gawler, 1814) from Amboyna (Ambon), Indonesia [the provenance is, however, questioned by some botanists (Blume, 1834; Jessop, 1979), and the natural habitat of this species is currently unknown], and *T. nutans* Wallich in J. Lindley (Hooker, 1831) from Eastern India.

Ridley (1909, 1924) reported that the fruit of *Tricalistra* is drupaceous and one-seeded. Jessop (1979) and Conran and Tamura (1998) reported it to be a drupe with a single seed. On the other hand, the fruit of *Tupistra* is reported to be a berry (e.g., Kurz, 1875; Wan, 1984; Liang & Tamura, 2000). It usually contains 1 to 3 seeds. As far as I could tell from examination, the fruit of *Tricalistra* (*Nur 32725*, GH, L) is morphologically very similar to that of *Tupistra*. It bears a thick, carnose pericarp and not a stony or hard endocarp, as in *Tupistra* (fruits of *Tupistra albiflora* are figured in Larsen, 1961). This indicates that their fruits are of the same kind, falling under the category of a berry. Ridley (1909) noted that he was not able to find a ripe fruit of *Tricalistra*. If he had seen ripe fruits, he may not have regarded the fruit of *Tricalistra* as drupaceous. He did state that the fruit of *Tricalistra* is similar to that of *Tupistra*. One fruit of *Tricalistra* I examined (*Nur 32725*, GH) contained one seed, coinciding with the previous reports. It is desirable, however, to examine more samples in order to see if the fruit of *Tricalistra* is consistently one-seeded.

According to Ridley (1909), the section of the ovary of *Tricalistra* shows traces of three carpels, but only one contains any ovules (actually 2 ovules). He therefore regarded the ovary as one-celled. Jessop (1979) described the ovary as one-celled, containing (2 or) 4 discord ovules but with traces of two further carpels. Conran and Tamura's

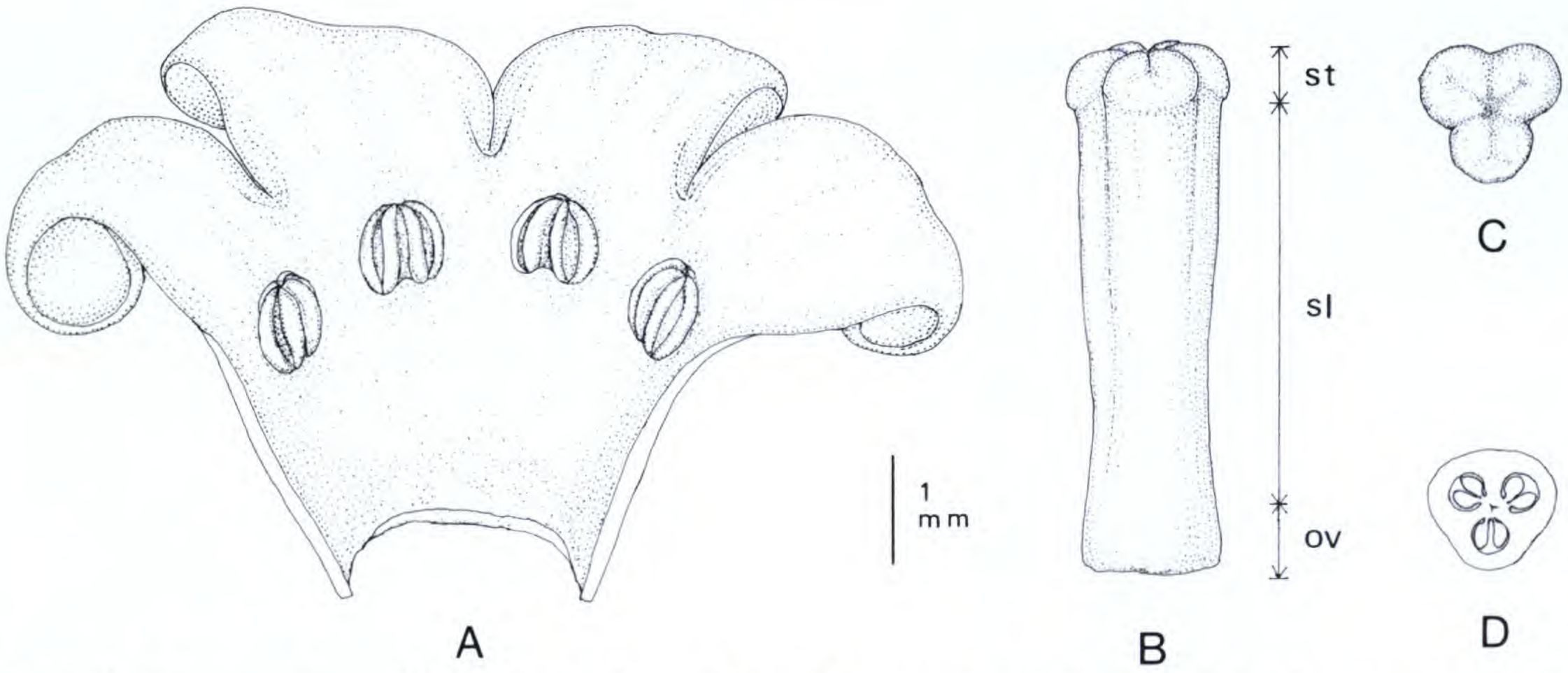

Figure 1. *Tupistra ochracea* (Ridley) N. Tanaka. —A. Partial flower cut longitudinally and slightly opened with pistil and part of perianth removed. —B. Longitudinal view of pistil. ov: ovary. sl: style. st: stigma. —C. Stigma in front view. —D. Diagram of cross section of ovary. Drawn by Noriyuki Tanaka: A, D from *H. N. Ridley 13692* (BM); B, C from *A. H. Batten Pooll s. n.* (SING).

description (1998) of the ovary is almost the same as Jessop's. In my observations, contrary to their reports, the ovary showed 3 normally developed locules, each containing 2 collateral ovules (Fig. 1D; *Batten Pool s.n.*, SING; *Nur 32725*, SING; *Ridley 13692*, BM). The ovary of *Tupistra* is also trilocular, each locule containing 2 collateral ovules (Hooker, 1831; Blume, 1834; Kunth, 1850). The result obtained herein shows that the two genera share the same locular feature of the ovary. In order to solve the above discrepancy between the present observation and the previous reports, further survey based on more specimens is needed.

As far as the present observations are concerned, *Tricalistra* and *Tupistra* do not seem to be distinct in any significant way. They share many essentially similar features in both vegetative and reproductive organs [e.g., tuberous rhizomes with cord-like roots, basal foliage leaves taller than flowering stems, comparatively large narrowly elliptic or oblanceolate leaf-blades attenuate into petiole, flowers borne in terminal spike, and fleshy more or less campanulate perianths (Fig. 1A)], and therefore can be regarded as congeneric. Considering their close proximity in various characters, the two genera may not even deserve a sectional delimitation.

Meanwhile, *Gonioscypha muricata* was originally described by Gagnepain (1934) from Laos. He reported that the fruit is densely tuberculate-muricate, capsular, and loculicidally dehiscent. However, from my examination of the type specimen, the fruits are hardly distinguishable from those of *Tupistra* and seem to be berries. The fruits of *Tupistra* are also often tuberculate-muricate (e.g., *Tupistra longispica* Y. Wan, as described in Wan, 1984). *Gonioscypha muricata* coincides well with *Tupistra* in all other respects, including vegetative and floral characters (e.g., shape of leaf blades, bracts, perianths, pistils, and stamens). There are no grounds to regard *G. muricata* as generically distinct from *Tupistra*.

From the reasons stated above, it seems more appropriate to transfer *Tricalistra ochracea* and *Gonioscypha muricata* to *Tupistra* as follows.

Tupistra ochracea (Ridley) N. Tanaka, comb. nov. Basionym: *Tricalistra ochracea* Ridley, J. Fed. Malay States Mus. 4: 83. 1909. TYPE: Indonesia. Pahang: Telom, Nov. 1900, *H. N. Ridley 13692* (lectotype, designated here, SING; isotypes, BM, K photo).

Other selected specimens examined. MALAYSIA. Malay Peninsula. **Pahang:** Cameron Highlands, Nov. 1939–Jan. 1940, *A. H. Batten Pooll s.n.* (SING 080488); Cameron Highlands (Sungai Bow, Bow Plantation), (ca.) 3700 ft., 23 Apr. 1937, *Md. Nur 32725* (GH, L 0068835, SING 052253).

Tupistra muricata (Gagnepain) N. Tanaka, comb. nov. Basionym: *Gonioscypha muricata* Gagnepain, Bull. Soc. Bot. France 81: 287. 1934. TYPE: Laos. Pak-lay, 1866–1868, *C. Thorel 3314* (holotype, P).

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New Taxa of Lauraceae from South America

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ABSTRACT. In this contribution the following new species of Lauraceae are described: *Cinnamomum floccosum* from Peru; five species of *Licaria*, *L. exserta* from Ecuador and *L. subsessilis* from Peru and Ecuador, *L. filiformis* from Peru, *L. sessiliflora* from Venezuela, and *L. rufotomentosa* from French Guiana; two species of *Mezilaurus*, *M. campaucola* from Peru, and *M. manausensis* from Brazil; one species of *Nectandra*, *N. tomentosa* from Ecuador and Peru; five species of *Ocotea*, *O. arenaria* and *O. multinervis* from Peru, *O. brevipetiolata*, *O. hirtostyla* and *O. scalariformis* from Ecuador; and one species of *Pleurothyrium*, *P. arcuatum* from Peru.

Key words: *Cinnamomum*, Lauraceae, *Licaria*, *Mezilaurus*, *Nectandra*, *Ocotea*, *Pleurothyrium*, South America.

Among Lauraceae specimens received as gift for identification or collected by staff of the Missouri Botanical Garden, several novelties were encountered. In this contribution 15 of these new species are published. More are certain to follow. None of the species described here are based on old collections, the oldest having been collected in 1982. Although most of the new species were collected in the Andes of Ecuador and Peru, it seems that new species of Lauraceae can be expected wherever intensive collecting takes place in the wet Neotropics.

I. Cinnamomum Schaeffer, Botanica Expeditor 74. 1760.

The Neotropical species of *Cinnamomum* were recently revised by Lorea Hernandez (1996). He recognized three species from Peru: *C. heteranantherum* (Ruiz & Pavón) Kostermans, only known from the type and characterized by its six 4-celled and three 2-celled stamens; the widespread *C. triplinerve* (Ruiz & Pavón) Kostermans; and *C. subsessile* (Meissner) Kostermans, characterized by its subsessile leaves with a rounded to cordate base. The last species was until recently only known from the type collected by Mathews in the 1830s but was re-collected in 2000 not far from the type locality. The new species described below differs markedly from any of the known species in Peru and Ecuador. *Cinnamomum* includes about 350 species, mostly in tropical Asia; Lorea Hernandez recognized 47 species in the Neotropics.

1. Cinnamomum floccosum van der Werff, sp. nov. TYPE: Peru. Dept. Cajamarca: prov. San Ignacio, Santuario Nacional Tabaconas-Namballe, Camino al Cerro Coyona, 2500–2600 m, 20 Nov. 1998, *C. Díaz, J. Sembrera & L. Adrianzen 10087* (holotype, MO 5593925; isotypes, HBG, K, NY). Figure 1.

A congeneris foliis basi cordatis vel rotundatis, venatione pagina superiori foliorum impressa et indumento floccoso valde recedit.

Trees, to 16 m. Twigs angular, solid, when young with a dense cover of straw-colored hairs, the hairs mostly ascending, the indument wearing off and becoming darker with age; terminal buds densely appressed pubescent. Leaves 5–11 × 3–6.5 cm, coriaceous, broadly elliptic to obovate, alternate and somewhat clustered toward the tips of the branches, the base obtuse to cordate, the margin flat, the apex obtuse or acute, the upper surface moderately floccose pubescent when young, becoming glabrous with age, the lower surface densely floccose pubescent, the hairs matted, the indument less dense with age and eventually becoming glabrous; domatia lacking; midrib and lateral veins and to a lesser degree tertiary venation impressed on the upper surface, raised on the lower surface; the basal 2 or 3 pairs of lateral veins crowded near the base of the lamina; lateral veins 5 to 8 on each side of the leaf; petioles to 5 mm long, with a similar indument to the twigs, shallowly canaliculate above. Inflorescences 5–10 cm, paniculate-cymose, in the axils of leaves, densely to moderately densely gray pubescent, the hairs ascending, the indument becoming sparser with age. Flowers yellow-green, 3–4 mm diam.; pedicels ca. 3 mm, less densely pubescent than the inflorescence axes; tepals 6, equal, 2 mm long, elliptic, glabrous or nearly so on the outer surface, sparsely pubescent on the inner surface, half-erect at anthesis; stamens 9, glabrous, 4-celled, the upper pair of cells sometimes much

MISSOURI
BOTANICAL GARDEN
HERBARIUM

Nº 5593925

PERU Holotype

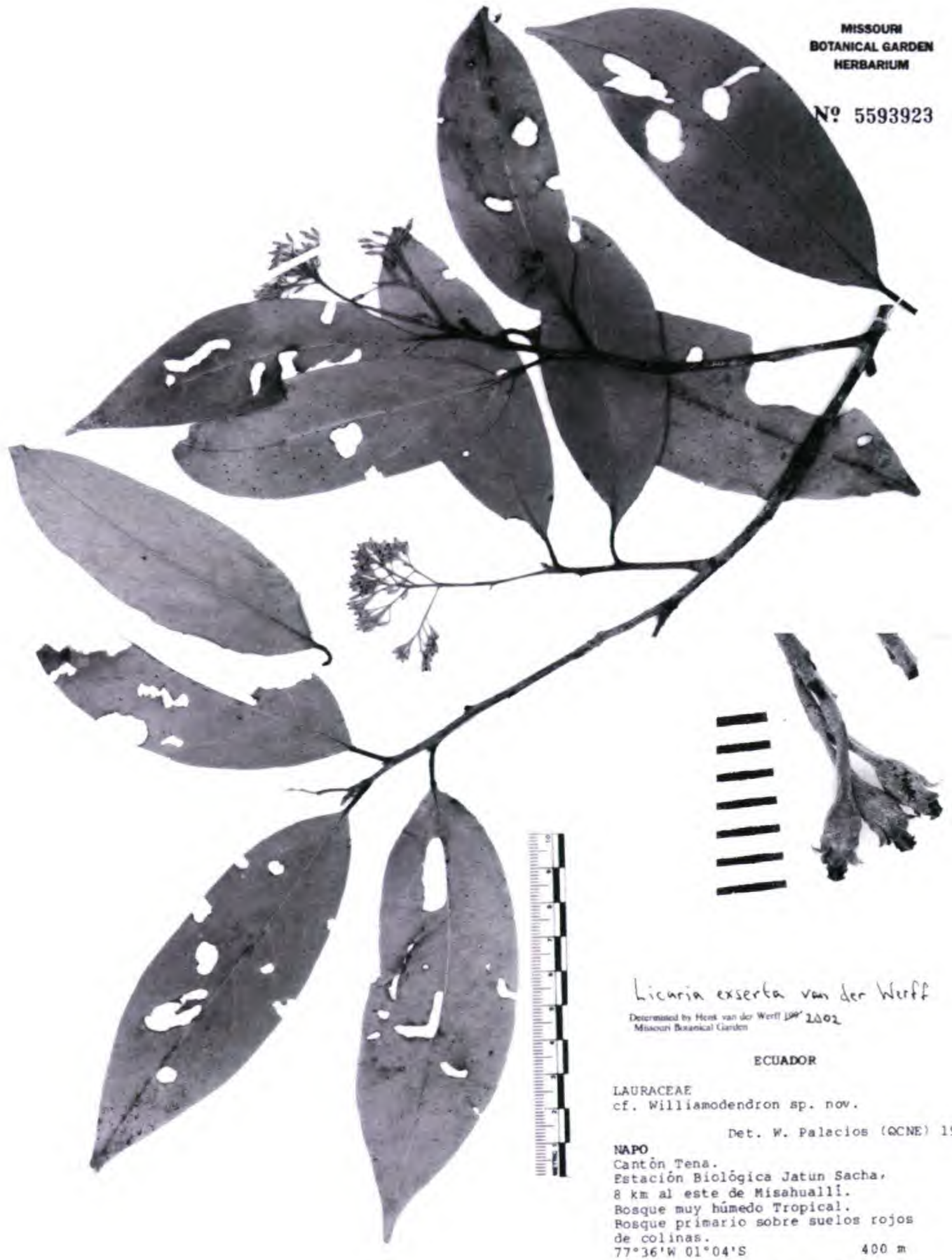
Cinnamomum floccosum v.d Werff

Cajamarca: San Ignacio

Tabaconas, Santuario Nacional
Tabaconas-Namballe. Camino al Cerro
Coyona. "Zona de amortiguamiento,
sector pajonal."
05°17'29"S 079°16'2"W 2500-2600 m

"Arbol 14 m, flores amarillo-verdosas,
ejes de la inflorescencia rojizo."
20 Noviembre 1998

"C. Diaz,
J. Sembrera & L. Adrianzen" 10087
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)



MISSOURI
BOTANICAL GARDEN
HERBARIUM

Nº 5593923

Licaria exserta van der Werff

Determined by Henk van der Werff 2002
Missouri Botanical Garden

ECUADOR

LAURACEAE
cf. Williamodendron sp. nov.

Det. W. Palacios (QCNE) 199

NAPO
Cantón Tena.
Estación Biológica Jatun Sacha,
8 km al este de Misahuallí.
Bosque muy húmedo Tropical.
Bosque primario sobre suelos rojos
de colinas.
77°36'W 01°04'S 400 m

Arbol de 30 m de altura. Olor muy
exquisito, fuerte y permanente a
sasafrás o anís en todas las partes
de la planta. Hojas subcoriáceas
brillantes. Flores amarillas. Tres
13 mayo 1990

Walter Palacios & E. Freire 5111
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

smaller and the anther appearing 2-celled, especially the inner 3 anthers, or inner 3 anthers 2-celled, stamens ca. 1.5 mm, the outer 6 with the cells opening introrsely, inner 3 opening extrorsely; filaments of the inner 3 stamens with 2 globose glands near the base, staminodia three, 1 mm, the apex triangular, the filament as wide as the tip, pubescent; pistil glabrous, 2.5 mm long, the ovary 1.5 mm, the style distinct; receptacle cup-shaped, pubescent inside. Tepals persisting and becoming enlarged, to 3 mm long, in old flowers and not dehiscing; fruits unknown.

Flowers in November.

Vegetatively, *Cinnamomum floccosum* is rather similar to *Aiouea dubia* (HBK) Mez, an Andean species known from southern Ecuador. Both species have somewhat tripliveined, obovate leaves; the major veins on the upper leaf surface can be impressed in *A. dubia*, although the tertiary venation is not impressed in the latter. *Aiouea dubia* has 2-celled anthers, although occasionally its anthers have a strongly reduced upper pair of locelli. The two species can be separated as follows: *C. floccosum* has 4-celled anthers (rarely anthers of the inner 3 stamens are 2-celled), floccose indument on leaves and twigs, mostly rounded to cordate leaf bases, and bullate leaves, while *A. dubia* has 2-celled anthers (rarely with rudiments of an upper pair of anther cells), glabrous or sparsely appressed pubescent twigs and leaves, acute to obtuse leaf bases, and the upper leaf surface flat or with impressed major veins.

Paratype. PERU. **Cajamarca:** Prov. San Ignacio, Santuario Nacional Tabaconas-Namballe, Camino al Cerro Coyona, 20 Nov. 1998, *Díaz et al. 10116* (MO).

II. Licaria Aublet, Hist. Pl. Guiane fr. 1: 313. 1775.

The revision of *Licaria* (Kurz, 2000) has greatly increased our understanding of this genus and made a critical examination and identification of the many recent collections possible. It was a surprise to find two new species of the subgenus *Cannella*, thus almost doubling the number of species in this subgenus. *Licaria* is typically characterized by the presence of three 2-celled stamens. One of the species described here, *L. exserta* van der Werff, differs in having two flaps on each of the anther locelli, thus having stamens with four anther flaps instead of two. This species also has the tepals united at the base and falling off as a unit in older flowers. Most species of *Licaria* have persistent tepals, and the position of *L. exserta* in *Licaria* is still provisional. *Licaria* is endemic to the Neotropics and includes about 50 species.

1. Licaria exserta van der Werff, sp. nov. TYPE: Ecuador. Napo Prov.: Jatun Sacha Biological Station, 400 m, 13 May 1990, *W. Palacios & E. Freire 5111* (holotype, QCNE 38693; isotypes, AAU, B, CANB, HBG, K, MO, NY, P, TI, US, XAL). Figure 2.

Licariae polyphyllae similis, sed antheris longe exsertis, quadri-valvibus, tepalis patentibus recedit.

Trees, to 30 m. Twigs terete, initially densely appressed pubescent, glabrescent, the indument inconspicuous; terminal buds densely and finely appressed pubescent. Leaves 8–14 × 3–5 cm, elliptic, firmly chartaceous, alternate; base shortly decurrent on the petiole, reflexed, the margin otherwise plane, the apex acute; upper surface glabrous, lower surface very sparsely appressed pubescent or glabrous, midrib slightly raised or immersed, lateral veins and tertiary venation immersed on the upper surface, midrib raised, lateral veins slightly raised or immersed, tertiary venation immersed on lower surface; lateral veins 5 to 7 on each side; petioles 0.8–11.4 cm, glabrous, deeply canaliculate. Inflorescences 4–10 cm, paniculate-cymose, moderately densely appressed pubescent, in the axils of bracts near the tips of the branches. Flowers 3–4 × 1.5 mm, yellow, cylindrical, densely appressed pubescent; tepals 6, equal, 1.5 mm long, the basal 1 mm fused into a tube, the free lobes 0.5 mm long, tepals dehiscing in old flowers and falling off as a unit together with the stamens; tepals initially erect, but spreading in older flowers; stamens 3, 1.5 mm long, free, pressed together in young flowers but diverging in older flowers, the inner surface densely pubescent, the outer surface less so, the filaments as wide as the anthers, 1 mm long, the anthers ca. 0.5 mm exserted, each anther with 2 anther cells, these narrow, ca. 0.4 mm long, extrorse, opening upward, each cell with 2 valves, one attached at the tip of the cell, the other at the middle; staminodia not seen; no glands visible at the base of the filaments; pistil 2.5 mm, glabrous, the ovary 1 mm, turbinate, the style slender, stigma

←

Figures 1, 2. —1 (left). Holotype of *Cinnamomum floccosum* van der Werff. —2 (right). Isotype (MO) of *Licaria exserta* van der Werff. Insert: Detail of flowers.

very small and inconspicuous, receptacle deep, densely pubescent inside. Fruits and cupules unknown.

Flowers in February, May, and June.

Licaria exserta can be readily recognized by its flowers to 4 mm long, with exserted anthers, the dehiscing tepals in old flowers, the anther cells with two valves each, the spreading tepals, and the slightly decurrent leaf bases with an inrolled margin. Although this species can be identified without difficulties, its generic placement is not certain. The new species is described in *Licaria*, based on the shape of the flowers and its three fertile stamens with exserted anthers. However, the anther cells with two valves each and the dehiscing tepals are not found in other species of *Licaria*. The genus *Williamodendron* Kubitzki & H. G. Richter has three stamens with four locelli and four valves each; however, *Licaria exserta* differs from *Williamodendron* in its evenly distributed (not clustered) leaves, its deep (not shallow) receptacle, its cylindrical flowers with exserted anthers (not rounded with included anthers), and the extrorse (not apical) locelli. I do not think that *Licaria exserta* is closely related to *Williamodendron*, although it has three stamens with four valves each. *Williamodendron* is closely related to *Mezilaurus* and differs from that genus only in its anthers with four, rather than two, locelli.

Kurz (2000) recognized three subgenera in *Licaria*; the new species belongs in the subgenus *Licaria* because the locelli are extrorse and open upward. The partly fused tepals and the cylindrical flowers indicate a similarity with *L. quirirafuina* Kostermans and *L. oppositifolia* (Nees) Kostermans, but *L. exserta* has larger flowers (3–4 mm vs. 1–2 mm) with long-exserted anthers, spreading tepals that dehisce in old flowers, and recurved leaf bases. The new species is only known from the Jatun Sacha Biological Station in Ecuador. Three of the four collections came from the same, tagged tree, and it is possible that the fourth collection also came from that tree. One collector mentioned that all parts of the plant were very fragrant.

Paratypes. ECUADOR. **Napo:** Jatun Sacha Biological Station, 16 Feb. 1999, *Neill & QCNE Botany Interns 12301*, 17 Feb. 1999, *Neill 11865*, 28 June 1994, *Tirado 995* (all MO, QCNE).

2. Licaria filiformis van der Werff, sp. nov. TYPE: Peru. Amazonas: Prov. Bagua, Comunidad Aguaruna Putuim, 600 m, 25 Sep. 1994, *C. Díaz, A. Peña & P. Atamain 7238* (holotype, MO 5593922; isotypes, HBG, MO, NY). Figure 3.

A congeneris floribus parvis inflorescentiisque filiformibus et cupulis laevibus recedit.

Shrub or small tree, to 6 m. Twigs terete, solid, slender, glabrous or with a few appressed hairs near the tip; terminal buds slender, finely appressed pubescent. Leaves 6–16 × 2–5 cm, elliptic, narrowly elliptic or oblong, chartaceous, alternate, the base acute, obtuse or rounded, the apex acute or acuminate, the acumen to 1 cm long, glabrous on both surfaces, midrib, lateral veins, and tertiary venation immersed on the upper surface, midrib raised, lateral veins and tertiary venation weakly raised on the lower surface, lateral veins 5 to 7 on each side, petioles 10–15 mm, glabrous, canaliculate. Inflorescences 5–8 cm, in the axils of bracts near the tips of the twigs, racemose or with a few cymose branches, glabrous. Flowers 1–1.2 mm diam., green, pedicels 5–9 mm long, threadlike, glabrous; tepals 6, equal, glabrous, 0.8 mm long, broadly ovate, the outer 3 erect, the inner 3 incurved; stamens 3, 2-celled, the locelli apical and opening outward, the tips of the stamens pressed together and with papillose margins, leaving only a small central pore for the stigma; old staminodia sometimes present on the cupule, 0.7 mm long, 0.5 mm wide near the tip, with some hairs near the base; pistil not studied for lack of sufficient flowers. Fruits ellipsoid, 2.2 × 1.4 cm, cupule deeply cup-shaped, 1 cm high, 1.4 cm diam., smooth, seemingly with a single margin, but a small, inner margin present; tepals sometimes persisting as small teeth on the cupule.

Flowers in August and September; fruits in September.

Licaria filiformis is an inconspicuous and poorly known species. It is readily recognized by its small flowers, slender inflorescences, often obtuse or rounded leaf bases, and the smooth cupule, which appears to have a single margin. It belongs to subgenus *Licaria* (Kurz, 2000); in Kurz's treatment it will key to *L. misantlae* (Brandegee) Kostermans, a Central American species, with which it shares the

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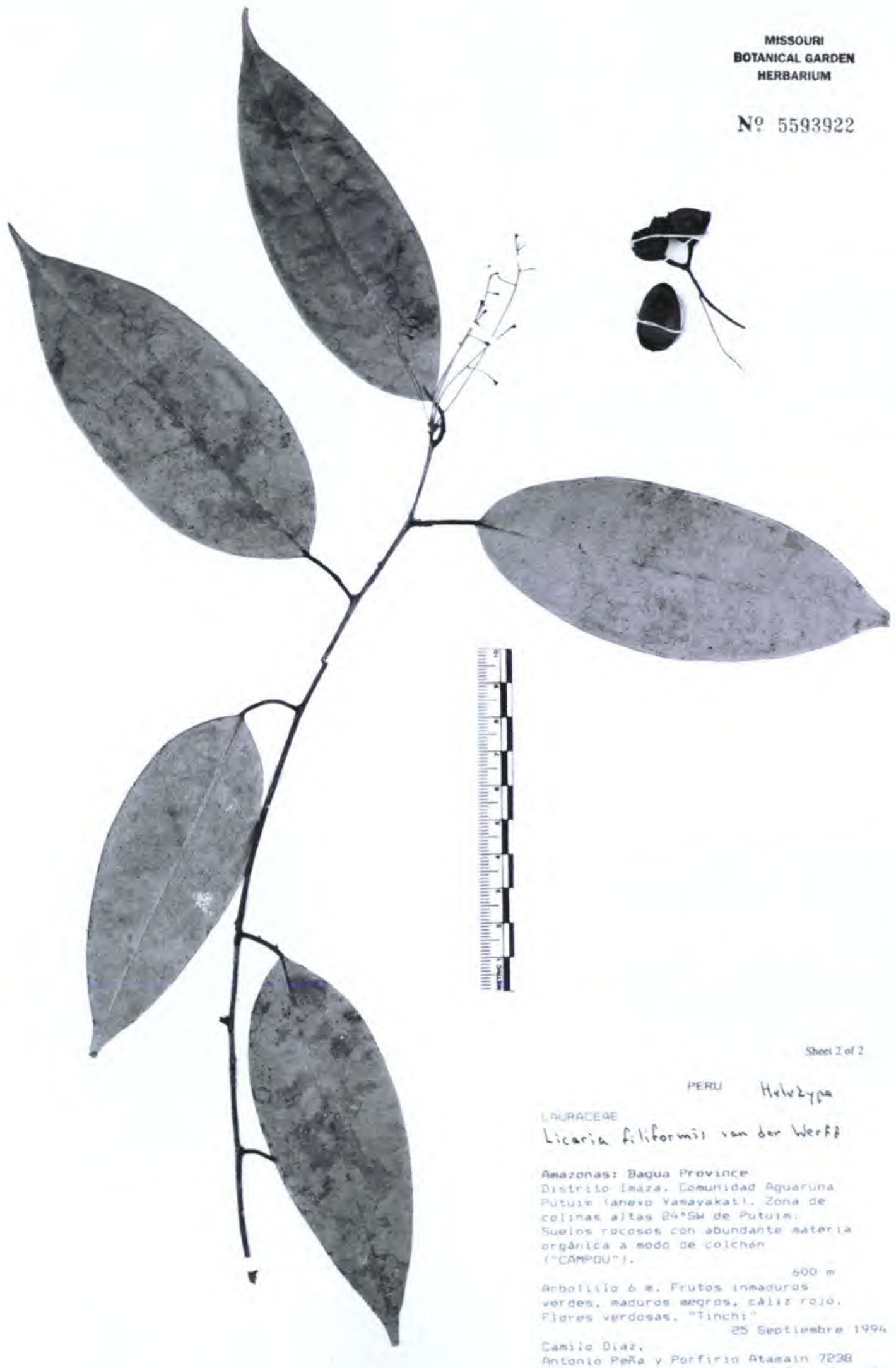
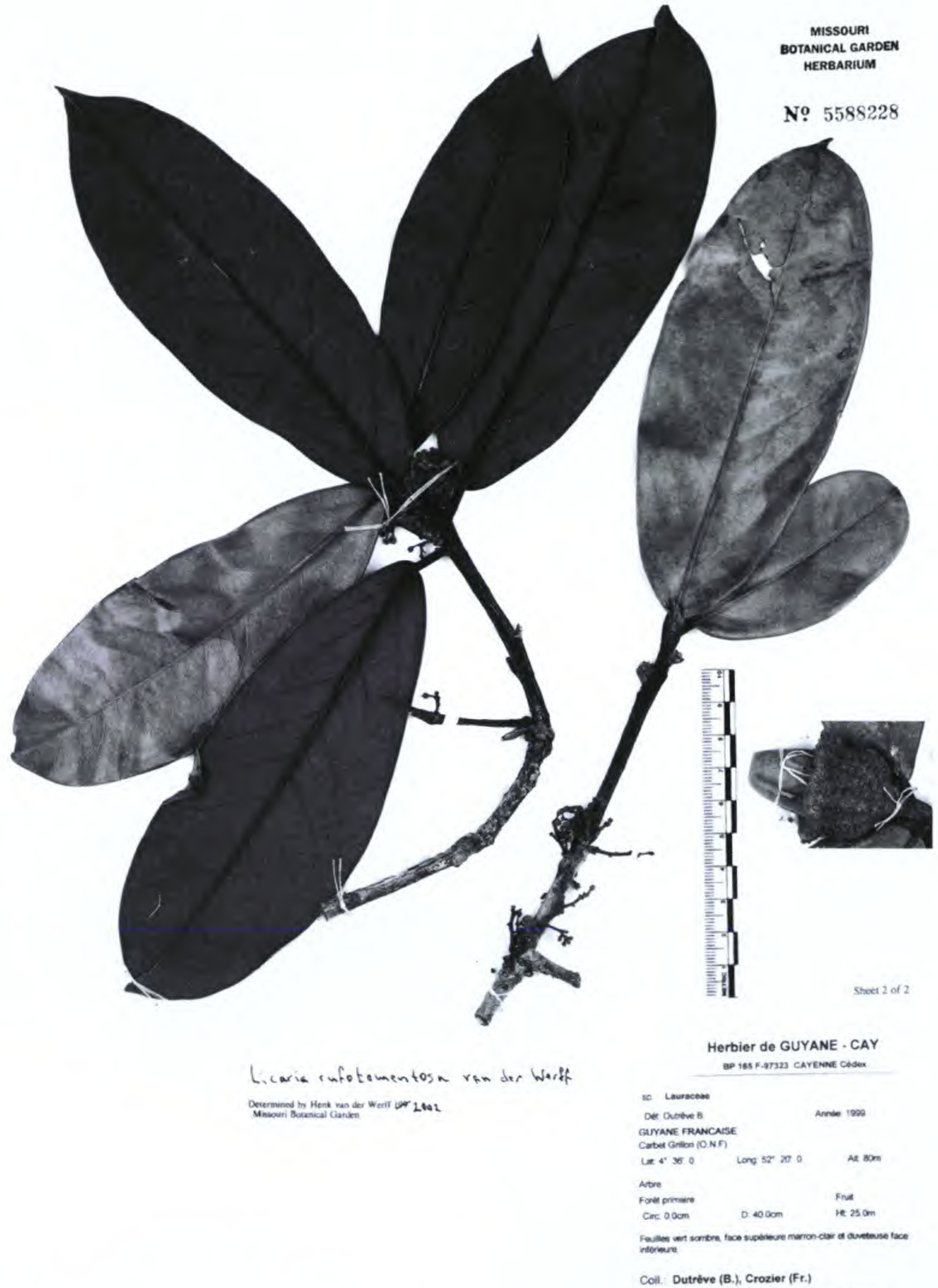
Figures 3, 4. —3 (left). Holotype of *Licaria filiformis* van der Werff. Insert: Cupule and fruit. —4 (right). Holotype of *Licaria rufotomentosa* van der Werff. Insert: Cupule and fruit.


MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5593922
Sheet 2 of 2
PERU Helv2ypa
LAURACEAE
Licaria filiformis van der Werff
Amazonas: Bagua Province
Distrito Imaza. Comunidad Aguaruna
Putuim (anexo Yamayakat). Zona de
colinas altas 24°SW de Putuim.
Suelos rocosos con abundante materia
orgánica a modo de colchón
("CAMPOU").
600 m
Arbolillo 6 m. Frutos inmaduros
verdes, maduros negros, cáliz rojo.
Flores verdosas. "Tinchi"
25 Septiembre 1994
Camilo Diaz,
Antonio Peña y Porfirio Atamain 7238
Proyecto auspiciado por la John D. and
Catherine T. MacArthur Foundation
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)


MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5588228
Sheet 2 of 2
Licaria rufotomentosa van der Werff
Determined by Henk van der Werff
Missouri Botanical Garden
Herbier de GUYANE - CAY
BP 165 F-97323 CAYENNE Cédex
sc. Lauraceae
Dét: Dutrêve B. Année: 1999
GUYANE FRANCAISE
Carbet Grillon (O.N.F.)
Lat: 4° 36' 0 Long: 52° 20' 0 Alt: 80m
Arbre
Forêt primaire Fruit
Circ: 0.0cm D: 40.0cm Ht: 25.0m
Feuilles vert sombre, face supérieure marron-clair et duveteuse face inférieure.
Coll.: Dutrêve (B.), Crozier (Fr.)
N° 7 Date 9-03-1999
Dupl: CAY-MO-P-K-US-NY

long (to 9 mm) pedicels. *Licaria misantlae* differs in its double-margined cupules, larger flowers (to 2.5 mm diam.), and distribution. The two collections of *L. filiformis* both came from a vegetation type locally called campau, forest on sandstone covered by a thick layer of leaf debris, but without a soil layer.

Paratype. PERU. **Amazonas:** Prov. Bagua, km 92 Carretera Bagua–Imacita, Cerros Chinim, 25 Aug. 1996, *C. Díaz, A. Peña & M. Roca 7952* (MO).

3. Licaria rufotomentosa van der Werff, sp. nov. TYPE: French Guiana. Carbet Grillon, 80 m, 9 Mar. 1999, *B. Dutrêve & F. Crozier 7* (holotype, MO; isotypes, CAY, K, NY, P, US). Figure 4.

A ceteris speciebus *Licariae* subgeneris *Cannellae* foliis subtus rufo-tomentosis, obovatis et ramulis juvenalibus rufo-tomentosis recedit.

Trees, 25 m. Twigs terete or ridged, seasonal growth densely dark red-brown tomentose, the surface completely covered; older twigs becoming glabrous; terminal buds densely tomentose. Leaves 8–18 × 3.5–7 cm, elliptic-obovate to obovate, coriaceous, grouped near the tips of the branches, alternate, the base obtuse or cordate, the margin often bent downward, the apex shortly acuminate, the upper surface glabrous except for some tomentose indument on the basal part of the midrib, the lower surface reddish tomentose, completely covered by the indument, the indument darker along the midrib; midrib, lateral veins, and tertiary venation slightly raised on the upper surface, midrib and lateral veins raised, tertiary venation not visible on the lower surface; lateral veins 7 to 10 on each side; petioles 6–10 mm, with a similar indument to the twigs, ± terete. Inflorescences 2 cm long, paniculate-cymose, densely tomentose, the surface completely covered by the indument, in the axils of leaves or bracts. Flowers ca. 2 mm long, globose or ellipsoid, densely tomentellous, the hairs shorter than those on the inflorescence axes, pedicels as long as or slightly longer than the flowers; tepals six, ca. 0.5 mm long, triangular or broadly triangular, equal or the outer 3 slightly larger, much shorter than the receptacle, densely tomentellous outside, glabrous inside, outer 6 stamens staminodial, tepaloid, a little smaller than the tepals, fertile stamens 3, representing whorl III, ca. 1 mm long, the basal part pubescent, the distal part glabrous, anther cells 2 longitudinal slits, introrse-latrorse, not opening with valves, glands, if present, fused with the broadened base of the stamens and difficult to discern; inner staminodia (whorl IV) not seen; pistil glabrous, 1.3 mm long, the ovary globose, 0.4 mm diam., style slender, stigma not distinct; receptacle deep, brown-pubescent inside. Infructescences short, excluding fruit to 5 cm, cupule 2.5–3 cm long, 3–3.5 cm diam., 1.5 cm deep, the outer margin spreading, fruit ellipsoid, ca. 3 cm long.

Flowers and fruits in March.

Licaria rufotomentosa is easily recognized by the ferruginous indument on the lower leaf surface, young twigs, and inflorescences. The clustered leaves, the introrse-lateral anther cells, and the large (to 3.5 cm diam.) cupules place the new species in *Licaria* subg. *Cannella.* It is closely related to *L. cannella* (Meissner) Kostermans, a variable species with three varieties (Kurz, 2000). In leaf characters (short petioles, leaf bases obtuse or rounded) the new species resembles the variety *tenuicarpa* (Kostermans) Kurz, but the tomentose indument on leaves and twigs is not known from any species of the subgenus *Cannella.*

The basionym of *Licaria cannella* is *Aydendron cannella* Meissner (Meissner, 1864). Later, Meissner (1866) used the spelling "*canella*" instead of "*cannella*" in the *Flora Brasiliensis* treatment, and this spelling has been used by all later authors. The spelling *cannella* in Meissner (1864) was probably based on the common name (Bois cannelle) cited in the original publication. Because *cannella* does not seem to be a typographical or orthographical error, article 60.1 of the *Code* (Greuter et al., 2000) requires that the original spelling be retained.

4. Licaria sessiliflora van der Werff, sp. nov. TYPE: Venezuela. Estado Amazonas: Río Pasimoni, 4 Nov. 1994, *B. Stergios, M. Niño, I. Sikoura, N. Piven, P. Martinez & N. Friederich 16276* (holotype, PORT; isotype, MO). Figure 5.

A congeneris floribus sessilibus tubulosisque, foliis reticulatis differt.

Tree, 8 m. Twigs terete, glabrous; terminal buds glabrous. Leaves 9–12 × 3–4 cm, elliptic or obovate-elliptic, glabrous on both surfaces, alternate or the two distal leaves subopposite, coriaceous, the

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Figures 5, 6. —5 (left). Isotype of *Licaria sessiliflora* van der Werff. —6 (right). Holotype of *Licaria subsessilis* van der Werff.

MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5593920
Licaria sessiliflora van der Werff
Determined by Henk van der Werff 199
Missouri Botanical Garden
Isotype
PLANTAS DE VENEZUELA
HERBARIO UNIVERSITARIO (PORT)
UNELLEZ GUANARE
Nº 16276
NYCTAGINACEAE
Neea sp.
Det. A. Licata & M. Niño, 1995
Arbol de 8 m. Botones florales rosados, fragantes.
ESTADO AMAZONAS. Segunda laguna en rio Pasimoni y orillas del mismo.
Mision Proyecto Vavilov, Convenio IVIC-NEBA-UNELLEZ.
4 de noviembre de 1994
Col. B. Stergios, M. Niño, I. Sikoura, N. Piven, P. Martinez y N. Friederich

MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5593919
PERU
Holotype
Licaria subsessilis van der Werff
Cajamarca: San Ignacio.
San José de Lourdes. Localidad de
Picorana. Bosque primario.
04°58'00"S 078°53'1"W 2250-2300 m
Arbol 14 m. botones blancos.
02 Diciembre 1998
J. Campos, L. Zurita & M. Camizan 5874
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

base acute or cuneate, the apex bluntly acute or obtuse, tertiary venation raised on both surfaces, midrib and lateral veins slightly raised on both surfaces; lateral veins 3 to 5 pairs; petioles 1.3–1.8 cm, strongly canaliculate. Inflorescences in the axils of bracts near the terminal buds, to 6 cm long, paniculate-cymose, toward the flowers minutely brown-puberulous. Flowers pink, sessile, the persistent bracts clasping the base of the flowers, tubular, 3–4 mm long; tepals 6, erect, much shorter than the floral tube, ca. 0.5 mm long; stamens 3, 2-celled, exserted at anthesis, the anther cells lateral or lateral-apical, opening sideways; staminodia 6, representing the outer 2 whorls, lanceolate, fragile, 1 mm long or more, just visible inside the flower and reaching the tips of the tepals; staminodia of whorl IV and glands at the base of the filaments of the stamens not seen; pistil glabrous, ca. 2 mm long, receptacle glabrous inside. Fruit unknown.

Flowers in November.

Licaria sessiliflora is a distinct species due to its sessile flowers, persistent bracts, and leaves with raised reticulation. Kurz (2000) recognized three subgenera in his revision of *Licaria*, primarily based on the opening of the anther cells. In the subgenus *Cannella* Kurz the anther cells open by slits and do not have flaps; in subgenus *Armeniaca* Kurz the anther cells open by flaps attached at the base of the anther cells, while in subgenus *Licaria* the anther cells open by flaps attached at the top of the anther cells. This new species does not fit in any of his subgenera: the flaps are attached laterally rather than at the top or bottom of the anther cells. Only one other species has anther cells opening in the same way: *L. debilis* (Mez) Kostermans, but this species has opposite, chartaceous leaves, lacks the raised reticulation, and has globose to ellipsoid flowers. The raised reticulation is shared with *L. puchury-major* (Martius) Kostermans, but the latter species has the anther cells opening by slits and lacks the flaps present in nearly all other species. Thus, the relationships of the new species are not clear.

5. Licaria subsessilis van der Werff, sp. nov. TYPE: Peru. Depto. Cajamarca: Prov. San Ignacio, Distr. San José de Lourdes, Cerro Picorana, 2250–2300 m, 2 Dec. 1998, *J. Campos, L. Zurita & M. Camizan 5874* (holotype, MO 5593919; isotypes, HBG, MO, NY, US). Figure 6.

A ceteris speciebus subgeneris *Cannellae* inflorescentiis floribusque tomentosis, foliis subsessilibus, basi rotundatis recedit.

Trees, 15 m. Twigs terete or angular, glabrous, solid, terminal buds glabrous or nearly so. Leaves 5–17 × 3–6.5 cm, coriaceous, alternate and clustered near the tips of the twigs, broadly elliptic to elliptic-obovate, the base rounded, rarely obtuse or cordate, to attenuate, the margins flat or slightly incurved, the apex obtuse or very shortly acuminate; glabrous on both surfaces, the lower surface densely gland-dotted; midrib slightly raised, lateral veins and tertiary venation immersed on the upper surface, midrib, lateral veins, and tertiary venation raised on the lower surface; lateral veins 6 to 10 on each side; petioles to 1 cm long, thick, flat above, glabrous. Inflorescences 2–12 cm long, paniculate-cymose, in the axils of leaves, densely red-brown tomentose, the surfaces completely covered. Flowers globose or a little longer than wide, ca. 3 mm diam., pedicels at anthesis about as long as the flowers or slightly shorter, the flowers often nodding; tepals 6, ca. 1.5 mm long, difficult to separate from the receptacle because of the dense indument, equal or nearly so, triangular, tomentose on the outer surface, glabous on the inner surface, outer 6 stamens staminodial, tepaloid, slightly smaller than the tepals; functional stamens 3, representing whorl III, 1.5 mm long, the anther cells appearing as longitudinal slits on the inner surface of the anthers, glands of the inner stamens lacking or completely fused with the filaments, staminodes of whorl IV not seen; pistil glabrous, 2 mm long, the receptacle deep, pubescent inside. Cupules with coarse warts, ca. 3 cm high, 4 cm diam., the margin 8 mm thick, fruits 3–4 × 3 cm.

Flowers in December and March; fruits in March.

The anther cells opening as introrse slits and the clustered leaves place *Licaria subsessilis* in subgenus *Cannella*. It differs from the other species in this subgenus in its tomentose inflorescences and flowers and its glabrous leaves. The lower leaf surface is densely gland-dotted. Its high-altitude habitat is also uncommon in *Licaria*. Three collections from southern Ecuador (Prov. Zamora Chinchipe, Estación Científica San Francisco, 2100 m alt.) differ from typical *L. subsessilis* in having an attenuate or acute leaf base, obovate-elliptic leaves, and petioles 5–10 mm long. At first I considered these specimens to represent a distinct species closely related to *L. subsessilis*. However, a very recent collection from this locality fits typical *L. subsessilis* perfectly. Because I think it highly unlikely that two closely related species, differing only in leaf characters, occur in the same locality, and because *L. cannella*, a lowland species closely related to *L.*

subsessilis, is quite variable in leaf characters, I provisionally place the specimens with attenuate leaf bases, obovate-elliptic leaves, and distinct petioles in *L. subsessilis*. Additional collections may well show that two species are involved, but as long as these collections are not at hand, it seems better to accept that *L. subsessilis* is variable in leaf characters.

Paratypes. ECUADOR. **Zamora Chinchipe**: Estación Científica San Francisco, 30 km E of Loja on road to Zamora, 2100 m, (fl, fr), *Chimbo & Chamba 95* (LOJA, MO, QCNE), (fl), *Homeier & Scheffer 303* (MO, QCNE), (fr), *Neill & QCNE Botany Interns 12619, 12620* (MO, QCNE).

III. **Mezilaurus** Taubert, Bot. Centralbl. 50: 21. 1892.

Mezilaurus is a small Neotropical genus with ca. 20 species. It was revised by van der Werff (1987) who accepted 18 species; however, 2 species were later transferred to the new genus *Williamodendron* (Kubitzki & Richter, 1987). The latter genus differed from *Mezilaurus* in its three 4-celled rather than 2-celled stamens. The androecium of *Mezilaurus* is thus similar to that of *Licaria*, but *Mezilaurus* differs from that genus in its clustered (not alternate) leaves and in its fruit, subtended by a small disc and not seated in a deep cupule as in *Licaria*.

1. **Mezilaurus campaucola** van der Werff, sp. nov. TYPE: Peru. Depto. Amazonas: Prov. Condorcanqui, Distr. El Cenepa, Cerro Tutino, 600 m, 24 June 1997, *R. Vásquez, A. Peña, E. Chavez, E. Quiaco & A. Ampam 24170* (holotype, MO 5593918; isotypes, HBG, K, NY, US). Figure 7.

Foliis apice obtusis, floribus glabris, pedicellatis *Mezilauri navalii* similis, sed foliis latioribus, staminibus dense pubescentibus et floribus latioribus quam longioribus recedit.

Trees to 20 m. Twigs terete, glabrous, with conspicuous scars of fallen leaves near the tips, terminal buds appressed pubescent. Leaves 8–16 × 4–7 cm, obovate or obovate-elliptic, coriaceous, clustered near the tips of the branches, the base attenuate, gradually narrowed into the petiole, the margin flat, the apex obtuse, rounded or emarginate; glabrous on both surfaces; midrib, lateral veins, and tertiary venation weakly raised on the upper surface, midrib raised, lateral veins and tertiary venation weakly raised on the lower surface; lateral veins 7 to 10 on each side; petioles poorly distinguishable due to the decurrent leaf bases, 1–2.5 cm long, glabrous, flat. Inflorescences 3–8 cm, in the axils of bracts near the tips of the branches, paniculate, the flowers clustered at the tips of the secondary axes or a few racemose along the secondary axes; glabrous or with a few appressed hairs. Flowers yellow, ca. 1.5 mm wide, 1 mm long (excluding the exserted anthers), pedicels 2–3 mm long, glabrous; tepals 6, broadly triangular, 0.5 mm wide, wider than long, glabrous on the outer surface, pubescent on the inner surface, erect or slightly incurved at anthesis; stamens 3, ca. 1 mm long, free, the densely pubescent filaments as wide as the glabrous anthers, anthers 2-celled, the cells extrorse, opening back to back, staminodia and glands not seen, pistil glabrous, 1.5 mm, the ovary ca. 1 mm, distinct from the slender style, stigma inconspicuous; receptacle bowl-shaped, glabrous inside. Fruits ± round, 2 cm diam., the tepals persisting and forming a disc with the receptacle, 5 mm diam.; pedicel not swollen in fruit.

Flowers in June, September, October, and November; fruits in June and October.

In the most recent revision of *Mezilaurus* (van der Werff, 1987), *Mezilaurus campaucola* would key to *M. navalium* (Allemão) Taubert ex Mez because of its glabrous leaves with rounded apices and its pedicellate, glabrous flowers. *Mezilaurus navalium* is only known from the Atlantic rain forests in southern Brazil and differs from the new species in its narrow leaves (to 3.5 cm wide vs. 4–7 cm wide in *M. campaucola*), and the shape of its flowers (longer than wide vs. wider than long in *M. campaucola*). It also has chartaceous leaves, while *M. campaucola* has coriaceous leaves. The epithet *campaucola* is derived from campau, the Aguaruna name for the soil type to which this species is restricted. Campau indicates soils not suitable for cultivation; these are mostly shallow soils on sandstone, covered with a thick, spongy humus layer. The vegetation on these soils is generally a low forest. Several species found on sandstone outcrops in the campau show a relationship with the flora of the sandstone mountains in the Venezuelan Guayana, such as *Euceraea nitida* Martius (Flacourtiaceae) and *Aratitiyopea* Steyermark & P. E. Berry (Xyridaceae).

The epithet is the deliberate choice of the author (Art. 23.2, St. Louis Code, Greuter et al., 2000) and is not to be regarded as a correctable error.

Paratypes. PERU. **Amazonas:** Prov. Bagua, Comunidad de Kampaenza, 25 Sep. 1994, *Jaramillo et al. 502* (MO); Comunidad Agauruna de Kusu-Listra, Cerro Apag, 18 Nov. 1996, *Díaz et al. 8518* (MO); Comunidad de Wawas, Tayu Mujaji, 25 Oct. 1997, *Rojas et al. 473, 496* (MO).

MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5593918

PERU Holotype

LAURACEAE
Mezilaurus campanicola van der Werff

Amazonas: Condorcanqui Province

Distrito El Cenepa, Comunidad de Tutino, Cerro Tutino. Bosque primario, sobre arenisca, suelo cubierto por un manto esponjoso de raices Campau. 04°33'50"S 78°12'15"W 600 m

Arbol 15 m, flores amarillas, frutos verdes.

24 Junio 1997

R. Vásquez, A. Peña,
E. Chávez, E. Quiaco & A. Ampam. 24170
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5593904

Sheet 1 of 2

INSTITUTO NACIONAL DE PESQUISAS DA AMAZÔNIA
Planta do Amazonas Holotype
Planta do Amazonia
INPA Nº 191995

LAURACEAE
Mezilaurus manausensis v.d Werff

B 190

Projeto Dinâmica Biológica de Fragmentos Florestais - PDBFF - Reserva 2206
tree # 1745 Arvore

Duplicatas distribuidas:
Instituto Nacional de Pesquisas da Amazônia
Overseas Development Administration

2. Mezilaurus manausensis van der Werff, sp. nov. TYPE: Brazil. Amazonas: Mun. de Manaus, Reserva No. 2206 do projeto Dinamica Biologica de Fragmentos Florestais, Tree no. 1745, *Mackenzie e equipe s.n., INPA/WWF 2206.1745* (holotype, MO 5593904). Figure 8.

Mezilauro micranthae similis, sed foliis chartaceis, floribus glabris, supra basin constrictis et indumento gemmarum terminalium ascendenti recedit.

Trees, height unknown; trunks to 18 m. Twigs terete, corky, initially appressed or ascending pubescent, soon becoming glabrous, with conspicuous scars of fallen leaves; terminal buds densely pubescent, the hairs ascending. Leaves 8–27 × 3–8.5 cm, elliptic to elliptic-obovate, chartaceous, clustered near the tips of the twigs, the base gradually narrowed into the petiole, the petiole often slightly winged, the margin flat, the apex acute; the upper leaf surface glabrous, the lower surface glabrous or with some appressed hairs along the major veins; midrib raised, lateral veins slightly raised and tertiary venation immersed on the upper surface, midrib, lateral veins, and tertiary venation raised on the lower surface; lateral veins 7 to 10 on each side; petioles poorly differentiated from the leaf base, 1–1.5 cm long, thickened at the base, terete or flat on the upper side. Inflorescences 3–7 cm, paniculate, glabrous, in the axils of bracts at the tips of the twigs, the flowers clustered at tips of the secondary axes, bracts pubescent, present at the base of the secondary axes and flowers. Flowers glabrous, 1.5 mm long, 2 mm wide, constricted above the base, the tepals erect, pedicels 3–4 mm long. Tepals 6, subequal, the outer 3 a little shorter than the inner 3, broadly triangular, the inner 3 ca. 0.5 mm long, the outer three 0.3–0.4 mm long; stamens 3, 0.8 mm long, the filament as wide as the anther, pubescent on the inner surface, shortly exserted, the anther cells visible above the shorter, outer tepals, anthers 2-celled, the cells extrorse, rather small, opening back to back; staminodia and glands not seen; pistil glabrous, 1.5 mm long, the slender style as long as the ovary; receptacle deeply cup-shaped, pubescent inside. Fruits ellipsoid, 2.5 × 1.3 cm, tepals persisting in fruiting stage, in young fruits clearly recognizable, in mature fruits transformed into a lobed disc, 5 mm diam.

Flowers in May and September; fruits in December and January.

Species of *Mezilaurus* are difficult to recognize due to their similarity in vegetative characters and small flowers. In the key to *Mezilaurus* species in van der Werff (1987), *M. manausense* would key to *M. sprucei* (Meissner) Taubert ex Mez, which differs in its long-pedicellate flowers, or *M. micrantha* van der Werff, which differs in its slightly pubescent flowers that are not constricted above the base, its clearly exserted anthers with large anther cells, and the strictly appressed indument of the terminal buds. Although the differences between *M. micrantha* and the new species are not striking, I describe *M. manausensis* as a new species because of its indument and floral differences from *M. micrantha*. The new species is only known from a number of specimens collected on plots made for the Biological Dynamics of Forest Fragments Project north of Manaus, Brazil.

Paratypes. BRAZIL. **Amazonas:** Mun. de Manaus, Projeto Dinamica Biologica de Fragmentos Florestais, flowering specimens: *Reserva 1301, tree 3221; 3258; 3412; 3587; 4106; Reserva 2303, tree 1707* (all MO); fruiting specimens: *Reserva 1113, tree 35; Reserva 1301, tree 5154; Reserva 3402, tree 971* (all MO).

IV. Nectandra Rolander ex Rottboell, Acta Lit. Univ. Hafn. 1: 279. 1778.

Nectandra is a rather large genus of about 115 species, recently revised by Rohwer (1993). No flowering material of the species described below was available during the preparation of his revision, and the fruiting specimens that were available were insufficient for a description. Recent flowering collections are the basis for the following description.

1. Nectandra tomentosa van der Werff, sp. nov. TYPE: Ecuador. Zamora-Chinchipe: Campamento Miazi along Rio Nangaritza, 900 m, 19 Feb. 1994, *H. van der Werff, B. Gray, E. Freire & M. Tirado 13268* (holotype, QCNE 104809; isotypes, AAU, HBG, MO, QRS). Figure 9.

A congeneris foliis cordatis, ramulis ferrugineo-tomentosis recedit.

Trees, 25 m tall. Twigs angular, ferruginous-tomentose, terminal buds tomentose. Leaves 13–30 × 4–10 cm, alternate, firmly chartaceous, elliptic to oblong, the apex sharply acute to acuminate, acumen to 3 cm long, toward the base gradually narrowed and at the base abruptly cordate; midrib

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Figures 7, 8. —7 (left). Holotype of *Mezilaurus campaucola* van der Werff. —8 (right). Holotype of *Mezilaurus manausensis* van der Werff.

MISSOURI
BOTANICAL GARDEN
HERBARIUM

Nº 5593905

ECUADOR Isotype

LAURACEAE
Nectandra tomentosa van der Werff

Zamora-Chinchipe

Campamento Miazi, in forest and cliffs along Rio Nangaritza. Forest on peaty soil.

900 m

Tree, 15 m. Flowers white. Fruits green. Young twigs rusty tomentose.

H. van der Werff, 19 February 1994
B. Gray, E. Freire & M. Tirado 13268
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

MISSOURI
BOTANICAL GARDEN
HERBARIUM

Nº 5593908

PERU Holotype

LAURACEAE
Ocotea granaria van der Werff

Amazonas

Scrub on sandy soil with rock outcrops. Utricularia, Eriocaulaceae, Xyris, Sphagnum present. A few km from Molinapampa.

Tree, 5 m. Flowers greenish. Tepals spreading at anthesis. Flowers pickled, DNA.

14 March 1998

Henk van der Werff,
B. Gray, R. Vasquez & R. Rojas 14941
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

and lateral veins impressed on the upper surface, prominently raised on the lower surface, tertiary venation immersed on the upper, raised on the lower surface; upper surface glabrous or with some appressed hairs along the major veins, lower surface glabrous or nearly so, but midrib and lateral veins minutely puberulous, the hairs appressed to ascending; axillary tufts of hairs absent; lateral veins 7 to 10. Petioles 5–10 mm long, with a similar indument to the twigs. Inflorescences in the axils of normal leaves, paniculate-cymose, to 15 cm long, the main axes tomentose, changing to appressed pubescent on the higher-order axes. Flowers white or green-yellow, 3–4 mm diam.; tepals 6, equal, ca. 1.6 mm long, ± spreading at anthesis, inside with the base sparsely papillose, the upper half densely so, outside sparsely appressed pubescent; base of tepals united and tepals falling off in old flowers as a unit. Stamens 9, 4-celled, ca. 0.5 mm long, with a distinct filament, a sterile tip lacking, the cells arranged in a shallow arc with the lower pair shifting toward a lateral position; staminodia 3, stipitiform. Pistil glabrous, ca. 1 mm long, the style about as long as the ovary. Receptacle inside basally glabrous, the upper part appressed pubescent. Fruit ellipsoid, 1.8 × 1.2 cm, cupule shallowly cup-shaped, warty, toward the base narrowed into the swollen pedicel.

Flowers in December, February, and March; fruits in September, December, and January.

Nectandra tomentosa is only known from the valley of the Rio Nangaritza, Ecuador, and adjacent Peru where it is fairly common along rivers and in forests adjoining the rivers on alluvial soil. Diagnostic for this new species is the combination of tomentose twigs and leaves with a cordate base. Floral characters such as stamens with distinct filaments, a relatively long style, and the absence of a sterile tip of the anthers indicate a close relationship to the *N. membranacea* complex of Rohwer (1993). Within this complex it is obviously close to *N. cordata* Rohwer, which has similar leaves with a cordate base. However, *N. cordata* has sparsely appressed pubescent twigs and inflorescences, quite unlike the indument in *N. tomentosa*; it is only known from the type, collected near Balsapuerto, Loreto, Peru. Fruiting specimens of *N. tomentosa* have been annotated by me previously as *N. cordata* and *N. cuneato-cordata* Mez and may have been distributed under those names.

Paratypes. ECUADOR. **Zamora-Chinchipe:** Rio Nangaritza, 12 Dec. 1990, *Neill & Palacios 9718A* (MO, QCNE), 6 Dec. 1990, *Palacios & Neill 6576* (MO, QCNE), 7 Dec. 1990, *Palacios 6602* (MO, QCNE), 7 Dec. 1990, *Neill 9577* (MO, QCNE), 28 July 1993, *Gentry 80529* (MO), 20 Feb. 1994, *van der Werff et al. 13333* (MO, QCNE, QRS). PERU. **Amazonas:** Prov. Condorcanqui, Rio Cenepa, Mamayaque, 20 Feb. 1997, *Vásquez et al. 22651* (MO); Prov. Bagua, Dtto. Imaza, Kusu-Listra, 19 Sep. 1996, *Díaz et al. 8297* (MO); along road Chiriaco–Bagua, 20 Mar. 2001, *van der Werff et al. 16242* (CANB, MO); Yamayakat, 6 Nov. 1996, *Vásquez et al. 21558* (MO), 20 Jan. 1973, *Kayap 192* (MO).

V. **Ocotea** Aublet, Hist. Pl. Guiane 2: 780. 1775.

Ocotea is the largest genus of Lauraceae in the Neotropics, with at least 300 species. A few species occur in Africa, and about 30 are known from Madagascar. Because of its size and lack of recent treatments, *Ocotea* species are difficult to identify or recognize. Additional species will almost certainly need to be described. Rohwer's (1986) synopsis of the genus has been helpful in our understanding of the species, but much work remains to be done, especially on the South American species. The Central American species have been treated by van der Werff (2002). A recent DNA-based phylogeny of Lauraceae (Chanderbali et al., 2001) has indicated that *Ocotea* is polyphyletic and that the species with bisexual flowers need to be separated from the species with unisexual flowers.

1. Ocotea arenaria van der Werff, sp. nov. TYPE: Peru. Amazonas: vicinity of Molinapampa, 14 Mar. 1998, *H. van der Werff, B. Gray, R. Vásquez & R. Rojas 14941* (holotype, MO 5593908; isotypes, B, HBG, K, NY, QRS, TI, US). Figure 10.

Ocoteae sericeae similis, sed floribus minoribus, tepalis intus dense pubescentibus, inflorescentiis late paniculatis recedit.

Small, dioecious trees, to 7 m. Twigs angular or ridged, solid, densely brown-tomentellous, the surface completely covered by the indument, this turning darker with age and finally wearing off; terminal buds densely brown-tomentellous. Leaves 6–11 × 1.5–2.5 cm, stiffly chartaceous, alternate, lanceolate or narrowly elliptic, the base sharply acute, narrowly decurrent on the petiole, the margin plane or slightly revolute near the base, the apex acute, sometimes bluntly so; midrib, secondary veins, and tertiary venation raised on the upper surface, the

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Figures 9, 10. —9 (left). Isotype (MO) of *Nectandra tomentosa* van der Werff. Insert: Cupule and fruit. —10 (right). Holotype of *Ocotea arenaria* van der Werff.

tertiary venation forming a fine reticulum, midrib raised, lateral veins and tertiary venation immersed or weakly raised on the lower surface; upper surface glabrous and shiny, on young leaves some short, curly hairs present near the base, lower leaf surface densely appressed pubescent, the surface completely covered, the indument not sericeous, vernation lines generally visible on young leaves, but not on older leaves; domatia absent; lateral veins 11 to 14 pairs, weakly developed and difficult to count; petioles 7–13 mm, flat above, with a similar indument to the twigs, the leaf bases often narrowly decurrent on the petioles. Inflorescences 6–14 cm, paniculate-cymose, densely tomentellous, the surface not visible, in the axils of leaves. Flowers green, 3–4 mm diam. when tepals erect, 5–6 mm diam. when tepals spreading; staminate flowers: tepals 2 mm long, broadly ovate, spreading at anthesis, densely brown-tomentellous outside, densely pubescent on the inner surface, both surfaces covered by the indument, stamens 9, 4-celled, the outer 6 stamens 1.2 mm, the filament pubescent, much shorter than the anther, anther cells opening introrse, inner 3 stamens 1.5 mm, the filament pubescent, about as long as the anther, glands present at the base of the filament, staminodia not seen, pistillode 1.5 mm, with a well-developed style and a thickened base, receptacle deep, pubescent near the upper rim, otherwise glabrous; pistillate flowers: tepals as in staminate flowers, but erect or half-erect at anthesis, staminodia 9, 0.6 mm, glands present at the base of the inner 3 staminodia, pistil 1.5 mm, the style about as long as the ovary, a stigma well-developed; receptacle deep, glabrous inside. Fruits and cupule unknown.

Flowers in March.

The dense, more or less appressed indument on the lower leaf surface, the vernation lines, and the much-branched inflorescences place *O. arenaria* in the *O. guianensis* group of Rohwer (1986). Within this group its closest relative is *O. sericea*, a high-altitude species reported from Venezuela, Colombia, and Ecuador. This species differs from *O. arenaria* in having wider leaves with a sericeous indument and a sharp, almost mucronate apex, tepals ca. 3 mm long and nearly glabrous on the inner surface, and larger stamens and pistil. *Ocotea arenaria* is presently only known from the vicinity of Molinapampa, at an altitude of 2300 m, near Chachapoyas, in the Department of Amazonas, Peru, where it was found in scrub on sandy soil, with several indicators of poor soils, such as *Utricularia* L., Eriocaulaceae, *Xyris* L., *Sphagnum* L., *Pterozonium brevifrons* (A. S. Smith) Lellinger, and *Doryopteris crenulans* (Fée) H. Christ. A few collections from Colombia, as yet unidentified, are close to *O. arenaria*, but differ in details of the indument. None of these collections have flowers, but two have fruits seated in double-margined cupules. Double-margined cupules are known to occur in two lowland species of the *O. guianensis* group, but had not been reported from Andean species at higher altitudes.

Paratype. PERU. **Amazonas:** a few km from Molinapampa in scrub on nutrient-poor sandstone, 13 Mar. 1998, *van der Werff et al. 14838* (MO).

2. Ocotea brevipetiolata van der Werff, sp. nov. TYPE: Ecuador. Prov. Zamora-Chinchipe: along new road Loja-Zamora, 2500 m, 25 Apr. 1987, *H. van der Werff & W. Palacios 9004* (holotype, QCNE 167077; isotypes, AAU, HBG, K, MO, NY, US). Figure 11.

Ex affinitate *Ocoteae floribundae*, sed petiolis perbrevibus, foliis basi rotundatis vel obtusis et floribus dense pubescentibus recedit.

Dioecious shrubs or trees to 20 m. Twigs ridged to clearly angular, glabrous. Terminal buds protected by glabrous bracts, inner bracts sometimes pubescent or with pubescent margins; bracts sometimes persisting as small, leaflike structures, to 2 cm long; scars of fallen bracts not clustered. Leaves 6–10 × 2.5–4 cm, rarely 15 × 8 cm, broadly elliptic to obovate-elliptic, alternate, frequently grouped together near the tips of the branches, coriaceous, glabrous on both surfaces, the base obtuse to rounded, the apex bluntly acute or obtuse; midrib, lateral veins, and tertiary venation immersed on the upper surface, midrib raised, lateral veins immersed and tertiary venation slightly raised on the lower surface; lateral veins 5 to 7 on each side; petioles 1–2 mm long, glabrous, flat above, the leaves nearly sessile. Inflorescences to 7 cm long, paniculate-cymose or racemose when small, near the base moderately or sparsely pubescent, the hairs ascending to erect, toward the flowers becoming densely tomentellous, the indument largely or entirely covering the surface; in the axils of leaves or bracts near the tips of the branches, often appearing terminal, but a terminal, vegetative bud al-

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Figures 11, 12. —11 (left). Isotype (MO) of *Ocotea brevipetiolata* van der Werff. Insert: Cupule and fruit. —12 (right). Isotype (MO) of *Ocotea hirtostyla* van der Werff. Insert: Cupule and fruit.

MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5593916
METRIC 1 2 3
ECUADOR
LAURACEAE
Ocotea brevipetiolata van der Werff
Prov. ZAMORA CHINCHIPE: Along new road
Loja-Zamora. Moist cloud forest on
peaty soil with Sphagnum and terrestrial
rosettes.
2900 m
Small tree; 4 m. Flowers whitish;
visited by small insects.
25 Apr. 1987
H. van der Werff & W. Palacios 9004
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5593910
METRIC 1 2 3
ECUADOR
LAURACEAE
Ocotea hirbostyla van der Werff
NAPO
Cantón Tena.
Estación Biológica Jatun Sacha,
8 km al este de Misahuallí.
Bosque muy húmedo Tropical.
Bosque primario sobre suelos rojos
de colinas.
77°36'W 01°04'S 400 m
Arbolito delgado de 6 m de altura;
5 cm DAP. Hojas coriáceas, envés con
nervaduras perdas. Flores masculinas
verdes.
13 mayo 1990
Walter Palacios & E. Freire 5100
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

ways present. Flowers unisexual, 6–7 mm diam., white, the pedicels 1–1.5 mm long; tepals 3 mm long, rather densely pubescent on the outer surface, moderately pubescent on the inner surface. Staminate flowers with 9 stamens, all 4-celled, the outer 6 stamens 2 mm long, glabrous, the anthers as long as the filaments, the locelli filling the entire anther and opening introrse; inner 3 stamens as outer 6, but the locelli opening extrorse-lateral and the filaments with 2 well-developed glands at the base; pistillode 2–2.5 mm long, pubescent, the style well-developed; receptacle shallow, pubescent inside. Pistillate flowers with 9 staminodes, these 1.5 mm long, with 4 rudimentary locelli each; the filaments slightly longer than the anthers, inner 3 staminodes with 2 glands at the base of the filaments; pistil 2.5–3 mm long, the glabrous ovary as long as the pubescent style, the stigma conspicuous, discoid. Fruits rounded, ca. 1 cm diam., the cupule very shallowly bowl-shaped to plate-like, with a double margin, the tepals persisting on the outer margin.

Flowers in March, April, and May; fruits in December.

Ocotea brevipetiolata is part of the *Ocotea floribunda* group (Rohwer, 1986) by virtue of its unisexual flowers, pubescent pistil, and plate-like cupule with a double margin and persistent tepals. It differs from the other species of this group in its short petioles, leaves with obtuse to rotund bases, glabrous terminal buds (or with at least the outer bracts glabrous), and the rather dense indument of inflorescences and flowers. *Ocotea floribunda* (Swartz) Mez is a widespread and somewhat variable species; it rarely occurs over 1500 m altitude. Rohwer (1986) included two Andean species in his *O. floribunda* group. One is *O. architectorum* Mez, known only from the type collected in Cajamarca, Peru, at 2700–2900 m; the other is *O. caniflora* Mez, known only from the type collected near Cuzco, Peru, at 1700 m. Both of these species have clearly petiolate leaves and cannot be confused with *O. brevipetiolata*. Our knowledge about the distribution of these species is still poor, due to a lack of good collections. Most collections of *O. brevipetiolata* are from southern Ecuador, but there are single collections from Colombia and Peru. A recent collection from the Reserva Maquipucuna in Ecuador belongs to *O. caniflora*, while the distribution of *O. architectorum* is still in question for lack of good specimens.

Paratypes. COLOMBIA. **Depto. del Valle:** Mpio. Tulua, old pistillate fl, *Devia 1989* (MO). ECUADOR. **Loja:** Carretera Loja–Zamora, cerca al cumbre, 23 Dec. 1991 (fr), *Rubio et al. 2265* (MO); Parque Nacional Podocarpus, along road from Yangana to Cerro Toledo, 29 Apr. 1987 (stam. fl), *van der Werff & Palacios 9193* (HBG, MO, QCNE), 29 Apr. 1987 (pist. fl), *van der Werff & Palacios 9194* (HBG, MO, QCNE); pass on the road Loja–Zamora, 9 May 1987 (pist. fl), *van der Werff 9452* (MO), 9 May 1987 (stam. fl), *van der Werff 9453* (MO). **Zamora Chinchipe:** along new road Loja–Zamora, 25 Apr. 1987 (fr, buds), *van der Werff & Palacios 9000* (MO, QCNE); along old trail from Nudo de Sabanillo to Vallodolid, 6 May 1987 (pist. fl), *van der Werff & Palacios 9382* (HBG, MO, QCNE), 6 May 1987 (pist. fl, fr), *van der Werff & Palacios 9386* (HBG, MO, QCNE). PERU. **Huánuco:** Huánuco–Tingo Maria road, km. 456, 13 Apr. 1977, *Gentry et al. 19304* (MO).

3. Ocotea hirtostyla van der Werff, sp. nov. TYPE: Ecuador. Prov. Napo: Cantón Tena, Estación Biológica Jatun Sacha, 400 m, 13 May 1990, *W. Palacios & E. Freire 5100* (holotype, QCNE 38682; isotypes, AAU, HBG, MO, NY, US). Figure 12.

Ocoteae floribundae affinis sed foliis subtus pilosis, ramulis tomentellis recedit.

Dioecious trees to 17 m. Twigs somewhat angular, densely brown-tomentellous, the surface of young twigs completely covered by the indument, becoming glabrous with age. Terminal buds densely brown tomentellous. Leaves 11–26 × 5–12 cm, alternate, broadly elliptic to broadly obovate, firmly chartaceous, the base acute, the apex acuminate, acumen to 2 cm long, but frequently broken off, upper surface glabrous or with some erect hairs along the major veins, lower surface pilose, the hairs soft to the touch, erect and scattered, but denser and becoming tomentellous along the lateral veins and midrib; lateral veins 6 to 9 pairs, venation immersed on the upper surface, midrib and lateral veins raised, tertiary venation weakly raised on the lower surface. Petioles 8–19 mm long, with a similar indument to the twigs. Inflorescences axillary, 5–15 cm long, densely brown tomentellous, paniculate-cymose. Flowers green, ca. 7 mm diam., the tepals ca. 3 mm long, ovate-elliptic, spreading, pubescent at both surfaces. Staminate flowers with nine 4-celled stamens, the outer 6 stamens ca. 2.5 mm long, the filaments ca. 1.5 mm long, moderately pubescent, the anther cells introrse, the upper 2 largely overlapping with the lower 2; inner 3 stamens of similar size, but anthers with 2 cells extrorse and 2 cells lateral; base of the filaments of the inner 3 stamens seemingly fused; 2 globose glands present at the base of the inner stamens; staminodia not seen; pistillode slender, ca. 2 mm long, pubescent, stigma present. Pistillate flowers with 9 staminodes, these ca. 1 mm long, the filaments sparsely pubescent or glabrous, glands present at the base of the inner 3 staminodes, pistil 3

mm long, the ovary glabrous, ca. 1.2 mm long, the style in bud folded in an S shape, becoming straight in open flowers, pubescent, receptacle glabrous inside. Fruits round to broadly ellipsoid, ca. 1.3 × 1.2 cm, seated on a thick, flat, plate-like cupule with a double margin.

Flowers in May; fruits in September–December.

Ocotea hirtostyla is closely related to the widespread *O. floribunda* and its allies, which are characterized by having pubescent styles and plate-like, thick cupules with a double margin and often somewhat persistent tepals on the cupules. *Ocotea hirtostyla* differs from the other species in this group by its tomentellous twigs and the soft, erect hairs on the lower surface of the leaves. It is currently only known from the Napo province in Amazonian Ecuador; all but one collection come from the Jatun Sacha reserve where collecting has been relatively intense. It can be expected elsewhere in Amazonia at the foothills of the Andes.

Paratypes. ECUADOR. **Napo:** Estación Biológica Jatun Sacha, 6 May 1990, *Palacios et al. 4930* (MO), 13 May 1990 (pist. fl), *Palacios & Freire 5106* (MO), 14 May 1990 (pist. fl), *Palacios & Freire 5146* (MO), 14 May 1990 (stam. fl), *Palacios & Freire 5160* (MO), 8 Sep. 1992 (fr), *Palacios et al. 10402* (MO), 6 Dec. 1988 (fr), *Palacios 3286* (MO), Sep. 1988 (fr), *Palacios 3003* (MO); Río Arajuno, Sola Cocha, Oct. 1995 (fr), *Neill et al. 6941* (MO); Napo, Cabeceras de la Quebrada Apayacu, 15 Dec. 1992 (fr), *Zuleta 63* (MO).

4. Ocotea multinervis van der Werff, sp. nov. TYPE: Peru. Dept. Piura: Prov. Morropón, Carretera entre Chalaco y San Miguel, 2000 m, 18 Oct. 1988, *C. Díaz & R. Vásquez 3030* (holotype, MO 5593912; isotypes, HBG, K, NY, US). Figure 13.

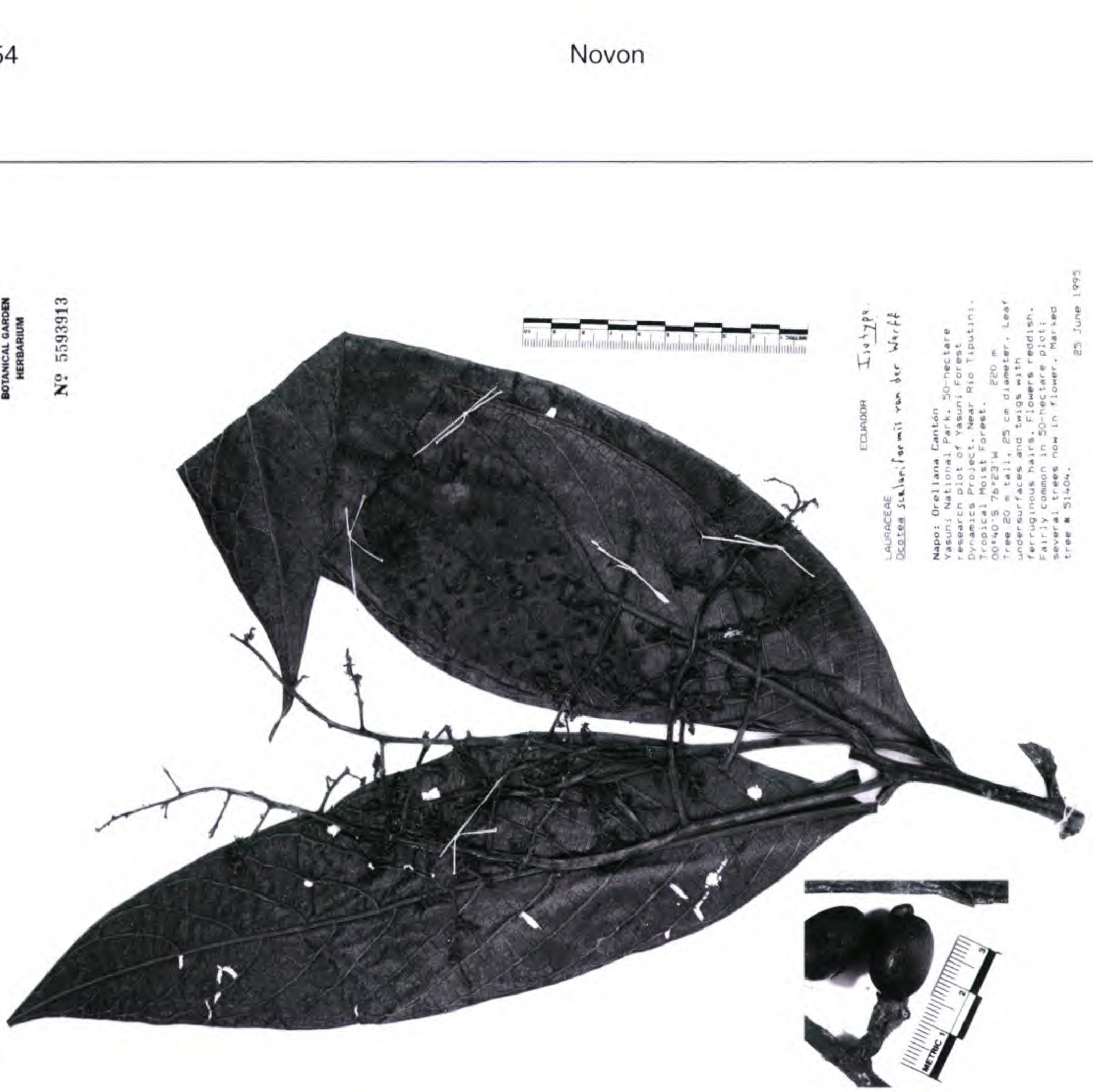
A congeneris nervis lateralibus numerosis et superficiebus ambabus tepalorum dense tomentellis recedit.

Trees, to 35 m. Twigs angular or ridged, 6–10 mm diam. 5 cm below the apex, densely tomentellous, glabrescent with age; terminal buds densely tomentellous. Leaves alternate or grouped near the tips of the branches, 9–17 × 4.5–8 cm, coriaceous, elliptic or broadly elliptic, the base cordate to obtuse, the apex obtuse, rarely somewhat acute, the upper surface glabrous, the lower surface densely tomentellous, the indument covering the surface completely; midrib immersed, lateral veins (slightly) impressed and tertiary venation not visible on the upper surface, midrib and lateral veins prominently raised, tertiary venation inconspicuously raised or not visible on the lower surface; domatia lacking; lateral veins 14 to 21 on each side; petioles short, to 5 mm long, but leaves often appearing sessile. Inflorescences in the axils of normal leaves or cataphylls, 5–14 cm long, densely tomentellous, the surface completely covered by the indument, paniculate-cymose. Flowers perfect (or unisexual?), 1 cm diam.; tepals spreading or reflexed at anthesis, elliptic, 3 mm long, densely tomentellous on both surfaces, the surface not visible, stamens 9, all 4-celled, the outer 6 ca. 1 mm long, sessile or nearly so, the upper pair of cells introrse, the lower pair almost latrorse, the anther dorsally pubescent, inner 3 with a short (about half as long as the anther) filament, the lower pair of cells extrorse, the upper lateral; glands at the base in the inner stamens sessile, globose; staminodia minute, stipitiform, with a few hairs; pistil glabrous, 1.5 mm long, receptacle initially rather deep, with some appressed hairs inside, but soon becoming shallow. Fruit ellipsoid, 2 × 1.5 cm, cupule very shallow, almost plate-like, ca. 1.5 cm diam., the pedicel slightly thickened and abruptly widened into the cupule.

Flowers in May and October; fruits in September.

Ocotea multinervis stands out by its tomentellous leaves with many pairs of lateral veins and by its tepals, densely tomentellous on both surfaces. It is a tall tree in montane forests between 2000 and 3000 m. Its relationships within *Ocotea* are not obvious. The two flowering collections (the type and *Cuamacas 81*) have anthers with open anther cells, but without any pollen grains remaining. Thus, I am not convinced that the flowers are hermaphrodite; it is possible that the flowers are unisexual, pistillate in the two flowering collections and that the staminodia are relatively well developed. Additional collections will show whether this is the case. In some flowers the glands at the base of the inner three stamens are rather strongly enlarged and protrude somewhat between the outer stamens, a character found in *Pleurothyrium*. However, all *Pleurothyrium* species with spreading tepals also have the glands fused in a disc and surrounding the stamens. In the new species the glands are not fused in a disc and therefore I prefer to place it in *Ocotea*, an already variable genus. One of the paratypes (*Cuamacas et al. 81*) was previously identified as *Ocotea arnottiana* (Nees) van der Werff and distributed under that name. A collection from Colombia (*Gentry & Cuadros 79141*, MO) resembles *O. multinervis* in leaf characters, but the young fruits and remnants of the tepals are nearly glabrous. Possibly it represents a related species, but more material is needed to solve its identity.

Paratypes. PERU. **Piura:** Montana de Cuyas, 8 km NE of Ayabaca, 26 Sep. 1991 (fr), *Gentry et al. 75116* (MO). ECUADOR. **Imbabura:** Caserío Tablachupa, Par-


MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5593913
ECUADOR Isotype
LAURACEAE
Ocotea sinclairii van der Werff
Napo: Orellana Canton
Yasuni National Park. 50-hectare
research plot of Yasuni Forest
Dynamics Project. Near Rio Tiputini.
Tropical Moist Forest.
00°40'S 76°23'W 220 m
Tree 20 m tall, 25 cm diameter. Leaf
undersurfaces and twigs with
ferruginous hairs. Flowers reddish.
Fairly common in 50-hectare plot;
several trees now in flower. Marked
tree # 51404.
25 June 1995
David Neill 10426
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)
METRIC
MISSOURI
BOTANICAL GARDEN
HERBARIUM
Nº 5593912
PERU Holotype
LAURACEAE
Ocotea multinervis van der Werff
Depto. PIURA: Prov. Morropón.
Carretera entre Chalaco y San Miguel.
2000 m
Arbol, 20 m. Flores blancas.
18 octubre 1988
Camilo Díaz y Rodolfo Vásquez 3030
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

roquia Plaza Gutiérrez, 13 May 1992 (fl), *Cuamacas et al. 81* (MO, QCNE). COLOMBIA. **Quindio:** Reserva del Alto Quindio Acaime, 10 July 1990 (fr), *Renjifo 143* (MO).

5. Ocotea scalariformis van der Werff, sp. nov. TYPE: Ecuador. Napo: Orellana Canton, Yasuni National Park, *D. Neill 10426* (holotype, QCNE 10426; isotype, MO). Figure 14.

Ocoteae tabacifoliae similis, sed basi foliorum decurrenti, fructibus ovoideis, venatione scalariforme et floribus subsessilibus recedit.

Dioecious trees, to 25 m. Twigs roundly angular to rounded, densely red-brown pubescent, the hairs erect and completely covering the twigs, terminal buds densely red-brown tomentose. Leaves 16–35 × 9–11 cm, alternate, firmly chartaceous, elliptic or broadly elliptic, rarely slightly ovate, the base acute and somewhat decurrent on the petiole, the margin slightly revolute, the apex acuminate, the acumen to 2 cm long, or appearing obtuse (but then probably damaged), the upper surface glabrous but with traces of pubescence on the major veins, the lower leaf surface moderately densely pubescent, the hairs erect, discernable to the touch, most of the surface visible, the indument denser and tomentose along the major veins, domatia lacking, midrib, lateral veins, and tertiary venation impressed on the upper surface, prominently raised on the lower surface, the tertiary veins connecting the lateral veins under an angle of 90°, and forming a regular, ladder-like pattern; lateral veins 12 to 15 on each side, petioles 1–1.5 cm, with a similar indument to the twigs, canaliculate. Inflorescences 20–30 cm, paniculate-cymose, red-brown tomentose, the surface completely covered, in the axils of leaves. Flowers 4–5 mm diam., moderately to densely puberulous outside, unisexual; pedicels 1–1.5 mm, shorter than the flowers, bracts subtending the flowers often persistent at anthesis and sometimes even after flowers have fallen off; tepals 6, equal, 2 mm long, elliptic, moderately to densely puberulous outside, ± spreading at anthesis, moderately pubescent on the inner surface. Staminate flowers: stamens 9, all 4-celled, ca. 1 mm, the filament ca. 0.1 mm, very short, pubescent, the anther glabrous, rectangular, the cells arranged in 2 pairs, introrse; inner 3 stamens 1.5 mm, the filament ca. 0.4 mm, pubescent, the anther glabrous, cells ± lateral; base of the filament with 2 small, globose glands; staminodia not seen; pistillode 1.2 mm, glabrous, the base swollen and containing an ovule-like body, pistillode with a small stigma, reaching in the flower as high as the base of the anthers; receptacle bowl-shaped, glabrous inside. Pistillate flowers: tepals as in staminate flowers; staminodia 9, ca. 0.5 mm, the short filament pubescent, otherwise glabrous, glands present at the base of the inner 3 staminodes; pistil 1.5 mm, glabrous, style ca. 0.6 mm, stigma platelike, a little wider than the style; receptacle deeply cup-shaped, with some appressed hairs inside. Fruits 20 × 13 mm, ellipsoid to ovoid, the cupule small, platelike, scarcely more than an undulating margin of the thickened pedicel.

Flowers in June and July; fruits in December.

Ocotea scalariformis can be confused with *O. tabacifolia* (Meissner) Rohwer. Both species have large, pubescent leaves with erect hairs, tomentose twigs, and have been reported from the Amazon lowland rain forest. However, *O. scalariformis* differs in its leaf bases, which are decurrent on the petiole (obtuse to rounded in *O. tabacifolia*), in its impressed venation on the upper leaf surface, in the prominently raised, scalariform venation on the lower leaf surface, in the ellipsoid to ovoid fruits (rounded in *O. tabacifolia*), and in the pistillode with a distinctly swollen base (pistillode threadlike in *O. tabacifolia*). The pistillode with a swollen base and the shape of the fruits do not suggest a close relationship with *O. tabacifolia*, but point to the *O. minarum* group of Rohwer (1986). The species of this group are vegetatively variable, but all share clearly pistillate and seemingly bisexual (fertile stamens and a pistil or pistillode with a swollen base) flowers and ellipsoid fruits seated on a small, platelike cupule. None of the species in this group resembles *O. scalariformis* vegetatively, but I feel that, based on flower and fruit characters, the new species belongs in the *O. minarum* group.

Paratypes. ECUADOR. **Francisco de Orellana:** Yasuni Scientific Station, 2 Dec. 1997 (fr), *Romoleroux et al. 3028* (MO), 15 July 2000 (pist. fl), *Villa 378* (MO).

VI. Pleurothyrium Nees, in Lindley, Nat. Syst. Bot. 442. 1836.

Pleurothyrium is a Neotropical genus recently revised by van der Werff (1993) who included 40 species in the genus. It is easily recognized by the enlarged glands at the base of the inner stamens.

←

Figures 13, 14. —13 (left). Holotype of *Ocotea multinervis* van der Werff. —14 (right). Isotype of *Ocotea scalariformis* van der Werff. Insert: Cupule and fruit.

Figure 15. Holotype of *Pleurothyrium arcuatum* van der Werff.

Often the glands protrude between the outer stamens and form a disc enclosing the stamens. Several species, including the one described below, have a pronounced brochidodromous venation.

1. **Pleurothyrium arcuatum** van der Werff, sp. nov. TYPE: Peru. Depto. Amazonas: Prov. Bagua, Yamayakat, 320 m, 11 Oct. 1995, *N. Jaramillo & D. Chamik 850* (holotype, MO 5593914; isotypes, HBG, K, NY, US). Figure 15.

A congeneris foliis glabris, alternis, apice acuminatis, venatione brochidodroma, ramulis solidis, juvenalibus castaneo-tomentellis recedit.

Small tree, 6 m. Twigs terete, solid, the apical part with the inflorescences densely brown tomentellous, the older parts glabrous, with a pale bark; terminal buds densely brown tomentellous. Leaves 10–20 × 4.5–7 cm, elliptic, coriaceous or firmly chartaceous, alternate, evenly distributed, the base acute or obtuse, the margin flat, the apex acuminate or acute, the acumen 1 cm long, glabrous on both surfaces except for some remnants of the tomentellous indument along the midrib, midrib immersed or slightly raised, lateral veins impressed, tertiary venation immersed on the upper surface, midrib and lateral veins raised, tertiary venation slightly raised on the lower surface; lateral veins conspicuously loop-connected, 8 to 12 on each side; petioles 1.5–2 cm, with a similar indument to the twigs, flat on the upper side. Inflorescences 4–10 cm,

moderately to densely brown-tomentellous, paniculate-cymose, in the axils of bracts near the tips of the branches. Flowers 7–8 mm diam., yellow, pedicels 2–3 mm long; tepals 6, ca. 3 mm long, elliptic, equal or the inner 3 slightly narrower than the outer 3, spreading in older flowers, the outer surface brown tomentellous, distally becoming papillose, inner surface papillose, stamens 9, 4-celled, the outer 6 with the anthers bent inward and the cells lateral, the inner 3 with the anther bent toward the outside and the cells lateral; the 2 cells on each side of the anther opening back to back; glands enlarged and forming a ring surrounding the stamens and obscuring the filaments; staminodia not seen; pistil ca. 2 mm, with a few hairs, the style short, ca. 0.5 mm; receptacle deeply cup-shaped, pubescent inside. Fruits and cupules not known.

Flowers in October.

In the key of van der Werff (1993), *P. arcuatum* would key to the last four species, based on its enlarged glands surrounding the stamens, glabrous, alternate leaves, and the papillose inner surface of the tepals. The conspicuously loop-connected lateral veins immediately set the new species apart in this group. *Pleurothyrium arcuatum* is only known from the type collection, made in the vicinity of the Marañon in northern Peru. The epithet *arcuatum* refers to the arcuate, loop-connected lateral veins.

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Revised Nomenclature and a New North American Record for the Villose Cliff Brake (*Pellaea*, Pteridophyta)

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ABSTRACT. Originally described by Fée in 1857, the villose cliff brake was not validly published for another 136 years. In 1993, this member of the Pteridaceae (*sensu* Tryon & Tryon) was named *Pellaea ternifolia* subsp. *villosa* Windham, acknowledging its overall similarity to the ternate cliff brake. Although formally including it within *P. ternifolia* (Cavanilles) Link, Windham suggested that the villose cliff brake was a probable allotetraploid produced by hybridization between typical *P. ternifolia* and some other (then unidentified) taxon. Recent work by Mendoza et al. has identified a new species, *P. ribae* Mendoza & Windham, that appears to be the "missing parent." Considering the evidence that the villose cliff brake is a reproductively competent taxon that originated as a hybrid between *P. ternifolia* subsp. *ternifolia* and *P. ribae*, we now feel that it should be recognized as a distinct species. Herein, we propose a new combination, *Pellaea villosa* (Windham) Windham & Yatskievych, for the villose cliff brake. We also report a northern range extension to Arizona, the second record for the area covered by the *Flora of North America*.

Key words: Arizona, North America, *Pellaea*, Pteridaceae.

While preparing a taxonomic treatment of *Pellaea* for Volume 2 of the Flora of North America Project (Windham, 1993b), the senior author determined that U.S. populations assigned to *Pellaea ternifolia* (Cavanilles) Link (Pteridaceae: subfam. Cheilanthoideae, *sensu* Tryon & Tryon, 1982) represent "three genetically distinct taxa characterized by differences in leaf morphology and chromosome number" (Windham, 1993a: 42). The most distinctive element, a tetraploid with sparsely villous fronds, was segregated as *P. ternifolia* (Cavanilles) Link subsp. *villosa* Windham, the villose cliff brake. Reported from a single locality within the boundaries of the *Flora* (Windham, 1993b), this taxon is relatively widespread in Mexico and probably originated there (Windham, 1993a). Considering this distribution, it is not surprising that subsequent work on the pellaeas of Mexico (Mendoza et al., 2001; Mickel, in press) has substantially improved our understanding of *P. ternifolia* subsp. *villosa*. These new data require a reconsideration of both the taxonomy and the known distribution of this taxon.

Pellaea ternifolia was first described (as *Pteris ternifolia* Cavanilles) in 1802. It has the most extensive distribution of any species in the genus, ranging from the southwestern United States to southern Chile, with disjunct populations in Hawaii and Hispaniola (Tryon, 1957). Within this vast range, there is considerable habitat diversity and ample opportunity for geographic isolation. These factors have combined to produce a puzzling array of morphotypes and an equally complex synonymy (Tryon, 1957: 150). Nearly all of the synonyms and proposed segregates have essentially glabrous leaves like the type material of *P. ternifolia* from Peru (*Née s.n.*; lectotype [designated by Christensen, 1937]: MA not seen; isolectotype: F). The first author to discuss the villose cliff brake *per se* was Fée (1857), who provided an accurate description and the provisional name "P. lanuginosa." Although impressed by the apparent distinctness of this taxon, Fée merely discussed it under *P. ternifolia* and stated that he wanted to see more material before recognizing it formally. Thus, the name "P. lanuginosa" Fée was considered a *nomen provisorium* by Tryon (1957), and has never been validated.

Since Fée's initial recognition of the villose cliff brake, its distinctive nature has become more evident. Alice Tryon noted a correlation between chromosome number and leaf morphology in *Pellaea ternifolia*, stating that "the tetraploid plants gen-

Table 1. Comparison of selected taxa belonging to the *Pellaea ternifolia* complex demonstrating the intermediacy of *P. villosa*. The characters listed for *P. ternifolia* apply only to the diploid cytotype of subspecies *ternifolia* (see text).

Characters	*P. ternifolia*	*P. villosa*	*P. ribae*
Rhizome scale shape	Linear-subulate	Linear	Linear-filiform
Rhizome scale length	5–7 mm	6–12 mm	8–15 mm
Rhizome scale coloration	Bicolored	Mostly bicolored	Concolored
Petioles and rachises	Glabrous or with a few scattered trichomes	± Villous	Densely villous
Distal portion of petioles	Grooved or flattened adaxially	Rounded to slightly flattened adaxially	Rounded adaxially
Pinnae	Ternately divided except at leaf apex	Usually entire for distal ⅓–½	Entire throughout
Abaxial pinna surfaces	Glabrous	Sparsely villous	Densely villous
Apical mucro on pinnae	Well-developed	Weakly developed	Absent
Largest ultimate segments	Usually <18 mm long	Usually >18 mm long	Usually <18 mm long
Mean spore size	39–45 μm	46–53 μm	53–60 μm
Chromosome number	$n = 29$ (diploid)	$n = 58$ (tetraploid)	Unknown

erally resemble the diploids, but the pinnae tend to be entire and the rachises more pubescent" (Tryon, 1972: 230). Based on isozyme profiles and additional chromosome studies, the senior author suggested that the "tetraploids are segmental allopolyploids produced by hybridization between typical *P. ternifolia* and other (as yet unidentified) diploid elements within the *P. ternifolia* complex" (Windham, 1993a: 42). With no specimens of the "missing parent" at hand, Windham (1993a, 1993b) took a conservative approach to the taxonomy of the group and recognized the villose cliff brake as a subspecies of *P. ternifolia*.

Subsequent work on the cliff brakes of Mexico (Mendoza et al., 2001; Mickel, in press) indicates that this classification needs revision. Central to our change in thinking is the discovery of *Pellaea ribae* Mendoza & Windham (Mendoza et al., 2001), the probable "missing parent" of the villose cliff brake. As shown in Figure 1 and Table 1, subspecies *villosa* is morphologically intermediate between diploid *P. ternifolia* subsp. *ternifolia* and *P. ribae* in nearly every character examined. From minute details of the rhizome scales to the more obvious features of frond dissection and pubescence, the villose cliff brake exhibits clear intermediacy. The only exception is in the length of the largest ultimate segments. These usually exceed 18 mm in subspecies *villosa* and are usually less than 18 mm in both diploid *P. ternifolia* subsp. *ternifolia* and *P. ribae* (Table 1). Such increases in frond segment size are common in hybrid ferns (e.g., Windham, 1988; Paler & Barrington, 1995) and may be attributable to heterosis (Grant, 1975).

Although morphological intermediacy is expected in taxa of hybrid origin, it rarely extends to mean spore size, as it does in the case of the villose cliff brake (Table 1). In general, allotetraploid ferns produce spores that are somewhat larger than either parent due to increased DNA content. The lack of a chromosome count for *Pellaea ribae* leaves open two possibilities. If spore sizes are strictly correlated with ploidy level in this group, then the materials of *P. ribae* currently at hand likely represent a polyploid derivative of the "missing parent" of subspecies *villosa*. Alternatively, *P. ribae* may exemplify a rare exception to the correlation between chromosome number and spore size. The species appears to be a strict gypsophile, and larger propagules might provide an adaptive advantage in such a harsh habitat. *Notholaena bryopoda* Maxon, another strict gypsophile that is known to be diploid, also has exceptionally large spores (Windham, unpublished). Plants of *P. ribae* derived from spores of the type collection currently are being grown at the Missouri Botanical Garden in hopes of testing these hypotheses.

Regardless of the actual chromosome number of *Pellaea ribae*, the data at hand indicate that the features distinguishing subspecies *villosa* from typical *P. ternifolia* derive from a genome shared with *P. ribae*. This genome is strikingly divergent from that of diploid *P. ternifolia*, confirming the suggestion (Windham, 1993a) that the villose cliff brake is an allotetraploid. Although subspecies *villosa* was formed originally by interspecific hybridization between *P. ternifolia* and *P. ribae*, we contend that it is a reproductively competent allopolyploid taxon

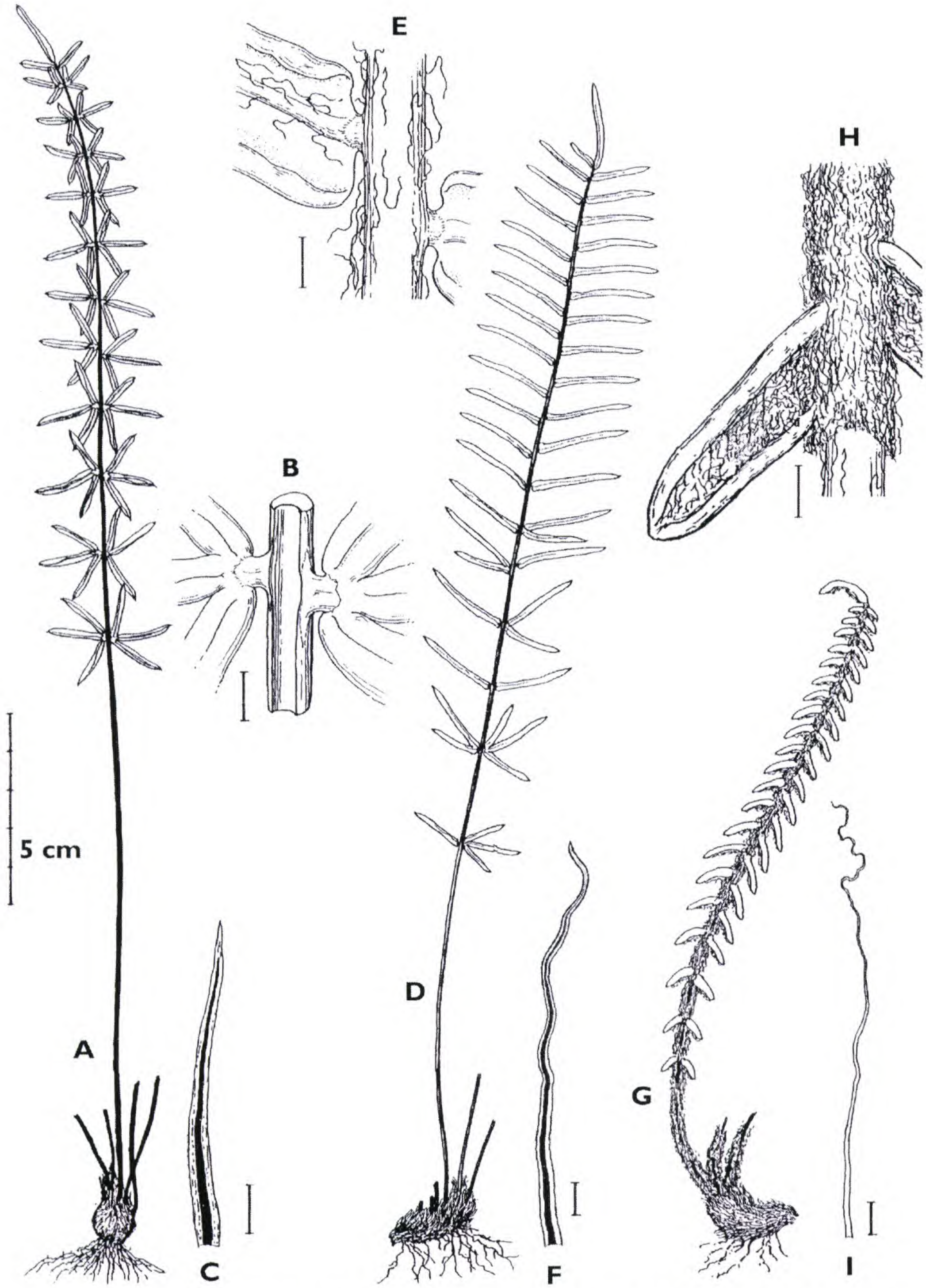

Figure 1. A–C. Diploid *P. ternifolia* (Cav.) Link subsp. *ternifolia* drawn from *Mickel 3849* (NY). —A. Leaf and rhizome. —B. Rachis and pinna attachment (adaxial surface). —C. Rhizome scale. D–F. *P. villosa* (Windham) Windham & Yatskievych drawn from *Rzedowski 22894* (NY). —D. Leaf and rhizome. —E. Rachis and pinna attachment (abaxial surface). —F. Rhizome scale. G–I. *P. ribae* Mendoza & Windham drawn from *Heil 5347* (BRY). —G. Leaf and rhizome. —H. Rachis and pinna attachment (abaxial surface). —I. Rhizome scale. Scale bar = 5 cm (A, D, G), 1 mm (B, C, E, F, H). Adapted from Mickel (in press).

that should be treated taxonomically as a separate species. It is amply distinct morphologically from both *P. ternifolia* and *P. ribae* (Table 1).

The appendix on nothotaxa in the *International Code of Botanical Nomenclature* (Greuter et al., 2000) states in Article H.5.1, "The appropriate rank of a nothotaxon is that of the postulated or known parent taxa." However, Article 5.2 states, "If the postulated or known parent taxa are of unequal rank, the appropriate rank of the nothotaxon is the lowest of these ranks." Given that we postulate that *P. villosa* arose following hybridization between a subspecies of *P. ternifolia* and the species *P. ribae*, these statements might be interpreted to require the continued recognition of *P. villosa* at the subspecific rather than specific level. We draw attention to problems of interpretation created by this section of the *Code*, especially as applied to fern nomenclature. The present practice among biosystematists, including most pteridologists, is to distinguish between primary hybrids and the reproductively competent taxa (sensu Wagner, 1954) that evolve from them following polyploidization. Such allopolyploids are reproductively isolated from either parent and function as full species; therefore we believe they should not be treated nomenclaturally as hybrids.

Although we considered validating Fée's *nomen provisorium* for this taxon, we have not seen the type (staff at P were unable to locate the specimen). Thus we are uncertain as to the precise application of the name. We therefore propose the following new combination based on the epithet applied by Windham (1993a):

Pellaea villosa (Windham) Windham & Yatskievych, comb. et stat. nov. Basionym: *Pellaea ternifolia* (Cavanilles) Link subsp. *villosa* Windham, Contr. Univ. Michigan Herb. 19: 43. 1993. TYPE: Mexico. Hidalgo: rocky hills, Lena Station, 8300 ft., 24 Aug. 1905, *C. G. Pringle 10025* (holotype, LL; isotypes, ARIZ, BRY, CAS, COLO, DAO, ENCB, F, GH, IND, KANU, LL, MSC, OKLA, SMU, TEX, UC, US, VT, WIS).

This species, occurring on various rocky substrates, is widespread in the Sierra Madre Occidental and Sierra Madre Oriental of northern and central Mexico. Mickel (in press) has identified specimens from the states of Chihuahua, Coahuila, Durango, Guanajuato, Hidalgo, México, Michoacán, Nuevo León, Puebla, San Luis Potosí, and Sonora. In the United States, the villose cliff brake has been reported from a single locality in the Davis Mountains of western Texas (Windham, 1993b). However, recent botanical surveys of the Madrean "sky islands" of southern Arizona have identified a second U.S. population:

U.S.A. **Arizona:** Cochise Co., Huachuca Mountains, Lone Mountain Watershed, Sycamore Canyon, above Mud Spring, 31°24′N 110°23½′W, elev. 5700 ft., E-facing slope just above arroyo bottom in pine-oak woods with *Juniperus deppeana, Quercus emoryi, Eragrostis, Muhlenbergia emersleyi, Cyperus, Bouteloua, Tradescantia, Ranunculus arizonicus, Ipomoea, Calliandra, Bommeria*, terrestrial; uncommon, 11 Aug. 1996, *M. Fishbein 2861, with K. Hooper & R. Coleman* (ARIZ).

This new population is situated approximately 300 km north to northwest of the closest known localities in the Sierra Madre Occidental and 600 km west-northwest of the only other U.S. collection site. It remains to be seen whether *Pellaea villosa* will be found in the mountains of southern New Mexico, which have fewer Madrean habitats. At the moment, it belongs to a group of species (including the ferns *Cheilanthes lendigera* (Cavanilles) Swartz, *Notholaena aschenborniana* Klotzsch, *N. neglecta* Maxon, and *P. ternifolia* (Cavanilles) Link subsp. *arizonica* Windham) that are known from Arizona and trans-Pecos Texas but not from intervening regions of New Mexico.

Acknowledgments. We are grateful to John Mickel for sharing his extensive knowledge of the taxa under consideration and for permission to use illustrations (skillfully drawn by Haruto Fukuda) from his upcoming book on the ferns and allied plants of Mexico. We thank Mark Fishbein for permission to publish his discovery of *Pellaea villosa* in Arizona, and express our gratitude to the curators of the cited herbaria for loans and access to their collections. Our reviewers, R. James Hickey, Gerald J. Gastony, Ruth Kirkpatrick, and Alan R. Smith, provided insightful comments that improved our discussion greatly. We also wish to acknowledge the Utah Museum of Natural History (UMNH) and the New York Botanical Garden (NY) for providing funding that made this work possible. Finally, we thank Jill Schwartz for her help with scanning and assembling the figure.

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A New Species and a New Specific Synonym of *Pedicularis* (Scrophulariaceae) from the Hengduan Mountains, China

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ABSTRACT. *Pedicularis inflexirostris* F. S. Yang, D. Y. Hong & X. Q. Wang, a new species from the Hengduan Mountains, China, is described. *Pedicularis inflexirostris* is different from *P. tatarinowii* Maximowicz in having more slender stems, fewer branches, a cucullate middle lobe of the lower corolla lip, and glabrous filaments. *Pedicularis deqinensis* H. P. Yang is reduced to a synonym of *P. ramosissima* Bonati on the basis of their common characters of long and dense branches, recurved calyx teeth, pilose indumentum on the inner margin of the calyx, and cucullate middle lobe of the lower corolla lip.

Key words: China, Hengduan Mountains, *Pedicularis*, Scrophulariaceae.

Pedicularis L., consisting of about 500 species, is the largest genus in the Scrophulariaceae. The genus, confined to the Northern Hemisphere, is a member of the arctic-alpine flora with the majority of species occurring in meadows. Recorded in China are about 352 species, of which 214 are concentrated in the Hengduan Mountains (western Sichuan, eastern Tibet, and western Yunnan), where most *Pedicularis* are endemic (Hong, 1983; Yang et al., 1998).

Due to the large number of species, high diversity of flowers, and extensive parallel evolution of floral characters in *Pedicularis*, it is difficult to reconstruct a natural intrageneric classification system. Quite a few influential but controversial systems have been proposed (Steven, 1823; Bunge, 1841; Maximowicz, 1888; Bonati, 1910; Limpricht, 1924; Li, 1948, 1949; Tsoong, 1955, 1963), but Li's (1948, 1949) and Tsoong's (1955, 1963) systems are the most outstanding. Li's system includes 3 groups, 22 sections, 79 series, and 282 species, while Tsoong's includes 13 groups, 21 subgroups, 112 series, and 329 species (Tsoong, 1963). Despite so many classification systems proposed, taxonomic research on *Pedicularis* in the eastern Himalayas, the modern diversity center of *Pedicularis*, is insufficient compared to the abundant *Pedicularis* species in the region.

In the summers of 2000 and 2001 we conducted an extensive field investigation on *Pedicularis* in the Hengduan Mountains and collected a large amount of *Pedicularis* specimens. Based on examination and identification of the specimens, we found a new species and nominated it as *Pedicularis inflexirostris* F. S. Yang, D. Y. Hong & X. Q. Wang on the basis of the inflexed beak. According to Li's system, the new species should be placed in the group *Cyclophyllum* sect. *Orthosiphonia* ser. *Myriophyllae* Maximowicz, while in Tsoong's system, it belongs to the grex *Orthosiphonia* Tsoong ser. *Myriophyllae* Maximowicz. The series *Myriophyllae* was founded by Maximowicz (1878) and redefined by Maximowicz (1888), Prain (1890), and Limpricht (1924). Li (1948) narrowed the circumscription of this series, removing *Pedicularis curvituba* Maximowicz and *P. anas* Maximowicz with curved and deflexed corolla tubes to form a new series, series *Curvitubae* Li. Therefore, the series *Myriophyllae* in Li's system includes four species, *P. myriophylla* Pallas, *P. alaschanica* Maximowicz, *P. tatarinowii*, and *P. provoti* Franchet, characterized by a deflexed beak and more or less straight corolla tube. Tsoong (1963) broadened the circumscription of the series *Myriophyllae*, adding a new species *Pedicularis pseudocurvituba* Tsoong, and transferring here *P. scolopax* Maximowicz and *P. cristatella* Pennell & Li from other series. Thus the series *Myriophyllae*, according to Tsoong (1963), includes seven species having a deflexed to straight and horizontal beak. Shown in the following key are the circumscription of the series and the distinctness of our new species.

KEY TO THE SPECIES OF SERIES *MYRIOPHYLLAE*

1a. Beak of corolla less than 1 mm long; lateral calyx lobes entire . . . . . *P. myriophylla*

1b. Beak of corolla 2–5 mm long; lateral calyx lobes serrate, pinnatifid, or entire.

2a. Beak of corolla 3–5 mm long; galea crested . . . . . *P. cristatella*

2b. Beak of corolla 2–3 mm long; galea not crested.

3a. Corolla purple-red; beak of corolla strongly inflexed.

4a. Middle lobe of lower lip cucullate; filaments all glabrous . . *P. inflexirostris*
4b. Middle lobe of lower lip elongated, not cucullate; filaments all pubescent . . . . . *P. tatarinowii*
3b. Corolla yellow; beak of corolla slightly curved.
5a. Bracts all or at least proximal ones longer than flowers; filaments all glabrous or only 2 glabrous.
6a. Corolla 2–2.5 cm long; anterior filaments villous, posterior ones glabrous . . . . . *P. alaschanica*
6b. Corolla ca. 1.5 cm long; filaments all glabrous . . . *P. scolopax*
5b. Bracts all shorter than flowers; filaments all pubescent.
7a. Basal leaves persistent; stems herbaceous, unbranched above; calyx at least ½ cleft at anterior . . . . . *P. pseudocurvituba*
7b. Basal leaves caducous; stems ± woody, short-branched throughout; calyx barely ⅓ cleft at anterior . . . . *P. curvituba*

Pedicularis inflexirostris F. S. Yang, D. Y. Hong & X. Q. Wang, sp. nov. TYPE: China. Tibet: Jomda County, Mt. Wangna, dry slope meadow, ca. 3700 m, 13 Aug. 2001, *F. S. Yang Y0180* (holotype, designated here, PE). Figure 1.

Species *P. tatarinowii* affinis, a qua caulibus tenuioribus medio 1–2.5 mm diametro, ramis paucioribus usque ad 4, galeae parte erecta graciliore 1.5 mm diametro, labio infero minore 8–9 mm lato, lobo medio cucullato, filamentis omnibus glabris differt.

Annuals, 20–45 cm tall, ± black when dry. Rootstocks vertical, woody, 4–8 cm long. Stems solitary or sometimes caespitose, 1–2.5 mm diam. at the middle part, erect, with 4 lines of hairs, and 0 to 4 branches at middle and upper parts of stems. Basal leaves opposite, middle and upper leaves in whorls of 4, long crisp pilose along petioles and nerves; petioles 1–2 cm long; laminae oblong-lanceolate, 15–30 × 8–15 mm, pinnatisect; dentate segments 10- to 13-paired, linear-lanceolate. Inflorescences to 15 cm long, interrupted at lower part; lower bracts similar to upper leaves in shape, top bracts dilated at the base, ovate. Calyx tube 5–7 mm long, membranous, with 10 thick veins and 5 triangular to lanceolate teeth, gray-tomentose. Corolla 13–15 mm long, pale purple, tube straight, as long as or slightly longer than the calyx; erect part of the galea 4–5 mm long, 1.4–1.5 mm wide, horizontal part of the galea strongly dilated to 4 mm wide; beak bent downward and backward, ca. 2 mm long; lower lip 6 × 8–9 mm, middle lobe cucullate, ½ as wide as lateral lips. Filaments glabrous. Capsules lanceolate.

Pedicularis inflexirostris resembles *P. tatarinowii* (ser. *Myriophyllae*) in having pinnatisect laminae, a straight corolla tube, and recurved beak, but differs from the latter in having more slender stems, fewer branches at the middle part, and thinner helmet (Table 1). The cucullate middle lobe of the lower lip and glabrous filaments are diagnostic characters of the new species, by which it is readily distinguished from *P. tatarinowii*. The lower lip of *P. inflexirostris* is also similar to that of the species in series *Longicaules* Prain (*P. dielsiana* Bonati, *P. longicaulis* Franchet) in shape, but the pinnatisect laminae, racemose inflorescences, and inflexed beak of the corolla show that *P. inflexirostris* is related to the grex *Cyclocladus* ser. *Myriophyllae* Maximowicz.

Habitat and distribution. *Pedicularis inflexirostris* is found in Garze County in western Sichuan, and Jomda and Qamdo Counties in eastern Tibet, at altitudes of 3700–3900 m, in meadows on dry slopes.

Paratypes. CHINA. **Tibet**: Qamdo County, Mt. Kajila, dry slope meadows, ca. 3700 m, 7 Aug. 2001, *F. S. Yang Y0150* (PE). **Sichuan**: Garze County, Mt. Zhuodala, dry slope meadows, ca. 3900 m, 2 Aug. 2001, *F. S. Yang Y0131* (PE).

Pedicularis ramosissima was described by Bonati (1908). Li (1948) placed it in the group *Cyclophyllum* sect. *Orthosiphonia* ser. *Pectinatae* Prain, while Tsoong (1963) treated it in the grex *Cyclocladus* subgrex *Cyclocladus* ser. *Graciles* Maximowicz. The series *Pectinatae* was founded by Prain (1890) and revised by Limpricht (1924). Li (1948) narrowed the circumscription of the series to include five species, *Pedicularis scolopax*, *P. moupinensis* Franchet, *P. tantalorhyncha* Franchet, *P. atuntsiensis* Bonati, and *P. ramosissima*, characterized by dilated and serrated bracts at the upper part of inflorescences, and more or less straight and horizontal beak. Tsoong (1963) redefined the series *Pectinatae* Prain to include only one new species, *Pedicularis rhynchotricha* Tsoong, with a twisted and pilose beak to distinguish it from the species in the series *Pectinatae* Prain of previous systems, transferring *P. ramosissima* to the series *Graciles*. Thus the series *Graciles*, according to Tsoong's system (1963), includes two species, *Pedicularis ramosissima* and *P. gracilis* Wallich, characterized by excessive branches at the upper part of stems and flowers with an elongated beak. The circumscription of the series and the distinctness of the two species are shown in the following key.

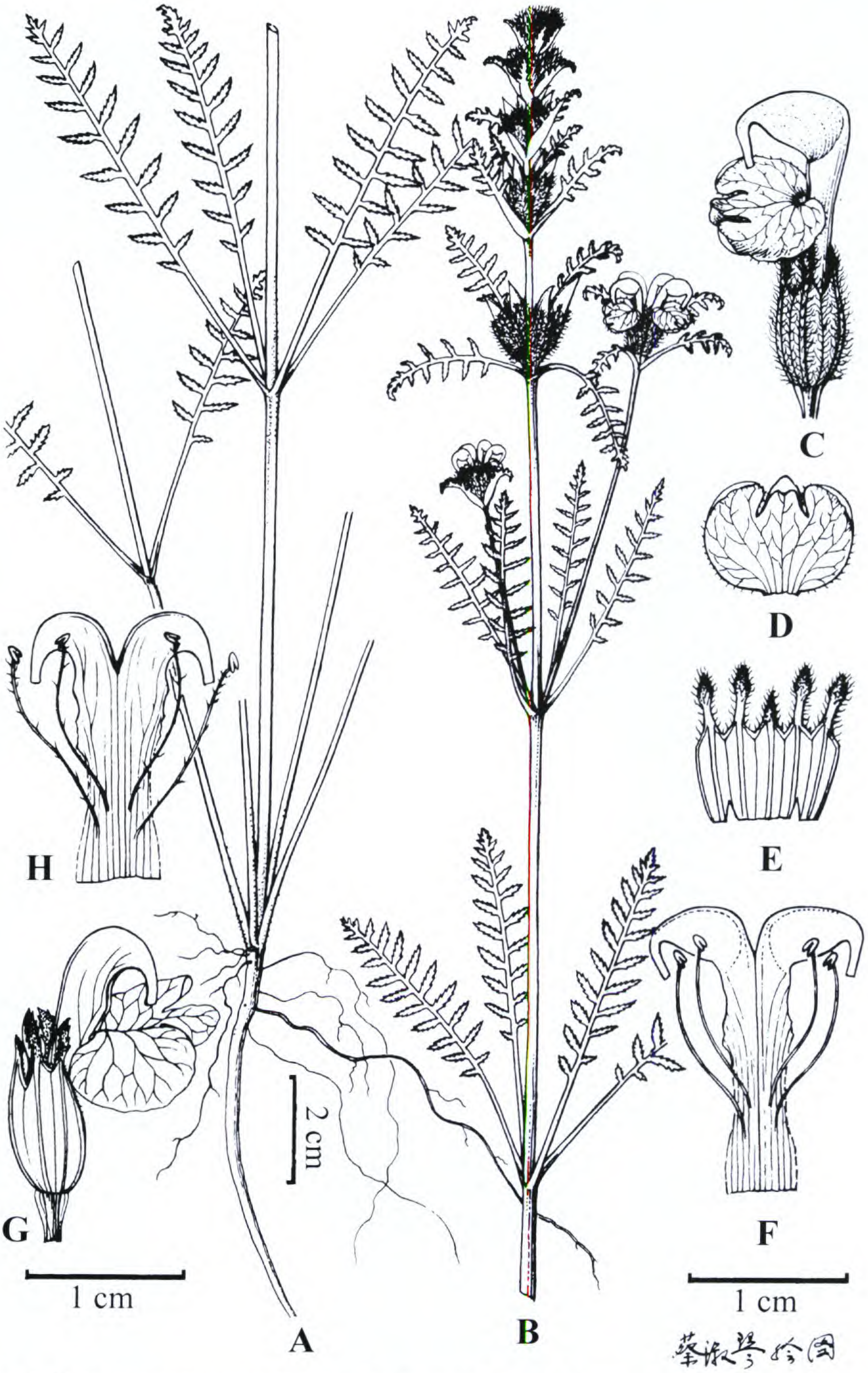

Figure 1. A–F. *Pedicularis inflexirostris* F. S. Yang, D. Y. Hong & X. Q. Wang. (Based on the collection *F. S. Yang Y0150*, PE.) —A, B. Habit. —C. Flower. —D. Lower lip. —E. Calyx. —F. Corolla and stamens. G, H. *Pedicularis tatarinowii*. (Redrawn from figure 48 in Tsoong, 1963.) —G. Flower. —H. Corolla and stamens.

Table 1. Diagnostic characters distinguishing *Pedicularis inflexirostris* from *P. tatarinowii*.

	Number of branches	Diam. of stems at middle part (mm)	Width of helmet at erect part (mm)	Width of lower corolla lip (mm)	Shape of middle lobe of lower corolla lip	Filaments
P. inflexirostris	0–4	1–2.5	1.4–1.5	8–9	cucullate	glabrous
P. tatarinowii	0–26	1.5–5	2.5–3	13–15	elongated, not cucullate	pubescent

Key to Species of *Pedicularis* in Series *Graciles*

1a. Calyx teeth recurved, pilose on inner surface; middle lobe of lower corolla lip cucullate . . . . . *P. ramosissima*

1b. Calyx teeth straight, glabrous on inner surface; middle lobe of lower corolla lip not cucullate . . . . . *P. gracilis*

Pedicularis ramosissima Bonati, Bull. Soc. Bot. France. 55: 246. 1908. TYPE: China. Sichuan: Yargong, Aug. 1904, *R. P. Soulié 5283* (holotype, P not seen, photo PE).

Pedicularis deqinensis H. P. Yang, Acta Phytotax. Sin. 28: 137. 1990. Syn. nov. TYPE: China. Yunnan: Deqen County, 2900–3400 m, 21 Aug. 1981. *Inst. Bot. Acad. Sin. Hengduanshan Exped. 3332* (holotype, PE; isotype, PE).

The original description of *P. ramosissima* was based on a single specimen, *Soulié 5283*. With more specimens examined, the description is revised here, adding some characters.

Stems 20–90 cm tall. Petioles 5–20 mm long, laminae 25–60 × 8–30 mm, dentate segments 5- to 12-paired. Calyx tube ca. 5 mm long with 5 teeth recurved. Corolla pale purple, 15–18 mm long, tube straight; erect part of galea 6–8 mm long; lower lip 8 × 12 mm, middle lobe cucullate.

Pedicularis deqinensis was noted by Yang (1990) to be close to *P. cristatella*, and was grouped, without further explanation, into series *Myriophyllae*, in which the latter also nested. Probably the elongated beak and the crest on the helmet were characters that prompted the author to relate *P. deqinensis* to *P. cristatella* and then to the grex *Orthosiphonia* ser. *Myriophyllae*. But in *Pedicularis*, convergent and parallel evolution of the corolla prevails, so that it may be unjustifiable to circumscribe intrageneric taxa based only on differences in the corolla (Li, 1951; Tsoong, 1955). Based on our observation of the specimens (*Inst. Bot. Acad. Sin. Hengduanshan Exped. 3332*) of *P. deqinensis*, long and dense branches in whorls of 4 at the middle and upper parts of stems and sparse, opposite or 3-verticillate flowers clearly indicate its position in the grex *Cyclocladus* ser. *Graciles*. Furthermore, all important characters of *P. deqinensis*, such as habit, arrangement of branches and flowers, shape of leaf and corolla, and size of calyx and corolla, are perfectly consistent with those of *P. ramosissima*. In particular, the recurved calyx teeth, pilose indumentum on the inner margin of the calyx, and cucullate middle lobe of the lower lip further indicate that *P. deqinensis* should be merged into *P. ramosissima*, and these characters are the principal ones to distinguish *P. ramosissima* from its close species in the series *Graciles*.

Habitat and distribution. *Pedicularis ramosissima* is found in Deqen County in western Yunnan and Zogang County in eastern Tibet, at altitudes of 2900–3700 m, under shrubs and *Quercus* forests.

Additional specimen examined. CHINA. **Tibet**: Zogang County, under shrubs at dry gravelly slope, ca. 3650 m, 18 Aug. 2001, *F. S. Yang Y0182* (PE).

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———, N. H. Holmgren & R. R. Mill. 1998. *Pedicularis* L. Pp. 97–209 *in* Z. Y. Wu & P. H. Raven (editors), Flora of China, Vol. 18. Science Press, Beijing, & Missouri Botanical Garden Press, St. Louis.

Taxonomic Novelties in *Andropogon* (Poaceae–Andropogoneae) for Brazil

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Abstract. *Andropogon brasiliensis* and *A. monocladus*, as well as a new variety, *A. ingratus* var. *hirsutus* from Brazil, are described. One new combination, *A. bogotensis* (Hackel) A. Zanin & Longhi-Wagner, is proposed. Morphological descriptions, illustrations, data on habitat, and geographical distribution are provided.

Resumo. *Andropogon brasiliensis* e *A. monocladus*, bem como uma nova variedade, *A. ingratus* var. *hirsutus* para o Brasil, são descritas. Uma nova combinação, *A. bogotensis* (Hackel) A. Zanin & Longhi-Wagner é proposta. São fornecidas descrições morfológicas, ilustrações, dados sobre habitat e distribuição.

Key words: Andropogoneae, Brazil, Gramineae, Panicoideae, Poaceae.

The genus *Andropogon* L. includes ca. 100 species (Clayton & Renvoize, 1986) distributed throughout the tropics, with centers of species diversity in Africa and tropical America (Clayton & Renvoize, 1982). Thirty species occur in Brazil, including *A. gayanus* Kunth, introduced from Africa for cultivation. In Brazil, the greatest species diversity is found in "cerrado" and "campos rupestres" of the southeastern and central-western regions.

Andropogon brasiliensis A. Zanin & Longhi-Wagner, sp. nov. TYPE: Brazil. Minas Gerais: mun. Congonhas do Norte, Serra da Carapina, 18°52′S, 43°14′W, 2 Mar. 1998, *R. C. Forzza, J. R. Pirani, A. C. Marcato, M. C. Assis & A. Rapini 694* (holotype, SPF; isotypes, FLOR, K). Figure 1.

Habitu *A. macrothrix* affinis sed praecipue laminis foliorum brevioribus et angustioribus, spiculis pedicellatis longioribus et ligula membranaceo-ciliata differt. Laminae 3.5–17 × 0.05–0.2(0.4) cm, ligula membranaceo-ciliata, inflorescentiae graciles, plerumque terminales tantum, 2–3(–5) ramis per spatheolam, spiculae pedicellatae (2–) 3.1–5 mm longae.

Perennial, caespitose; culms 34–64 cm tall, glabrous; 3 to 5 glabrous nodes. Leaf sheaths usually shorter than the internodes, glabrous; *blades* 3.5–17 × 0.05–0.2(–0.4) cm, linear, usually conduplicate, margins convolute or involute, apex acute or subobtuse, base straight, green on both faces, glabrous on abaxial face, puberulous on adaxial face, usually setose in the proximal portion, with marginal or submarginal hairs 2–5 mm long, apex scabrous on the margins; *ligule* 0.2–0.6 mm long, membranous ciliate. *Inflorescence* 2.5–6 cm long, lax, elongated, usually composed of terminal, or both terminal and axillary inflorescence units, these units with 2 to 3(to 5) non-branched flowering branches, equal or subequal in length, conjugate or subdigitate, exserted or partially enclosed by the spatheole; peduncle of the inflorescence unit 8–19 cm long; spatheole 5.5–14 cm long. *Pedicels and rachis internodes* 2–3(–4) mm long, linear, subequal in length, with hairs shorter than the sessile spikelet or as much as 1.5 times its length. *Sessile spikelet* 4.5–6.5 mm long, monoclinous, stramineous-green; *lower glume* 4.5–6.5 × 0.6–1 mm, slightly concave, lanceolate, bidentate, chartaceous, 4-nerved, without intercarinal nerves, without groove, scabrous on the upper third of the nerves, margins glabrous; *upper glume* 4.1–5 × 0.8–1.4 mm, acute or apiculate, chartaceous, 3-nerved, scabrous on the upper third of the central nerve, ciliate on the upper half of the margins; *lower lemma* 3.9–4.5 × 0.7–1 mm, hyaline or hyaline vinaceous, 2-nerved, ciliate on the upper half of the margins; *palea* absent; *upper lemma* 3–4 × 0.4–0.9 mm, perfect hyaline or stramineous hyaline, 3-nerved, glabrous or sparsely ciliate on the margins; apex bifid on the upper third or quarter, awned, awn 12–22 mm long; *palea* 1.2–2.8 × 0.3–0.7 mm, hyaline,

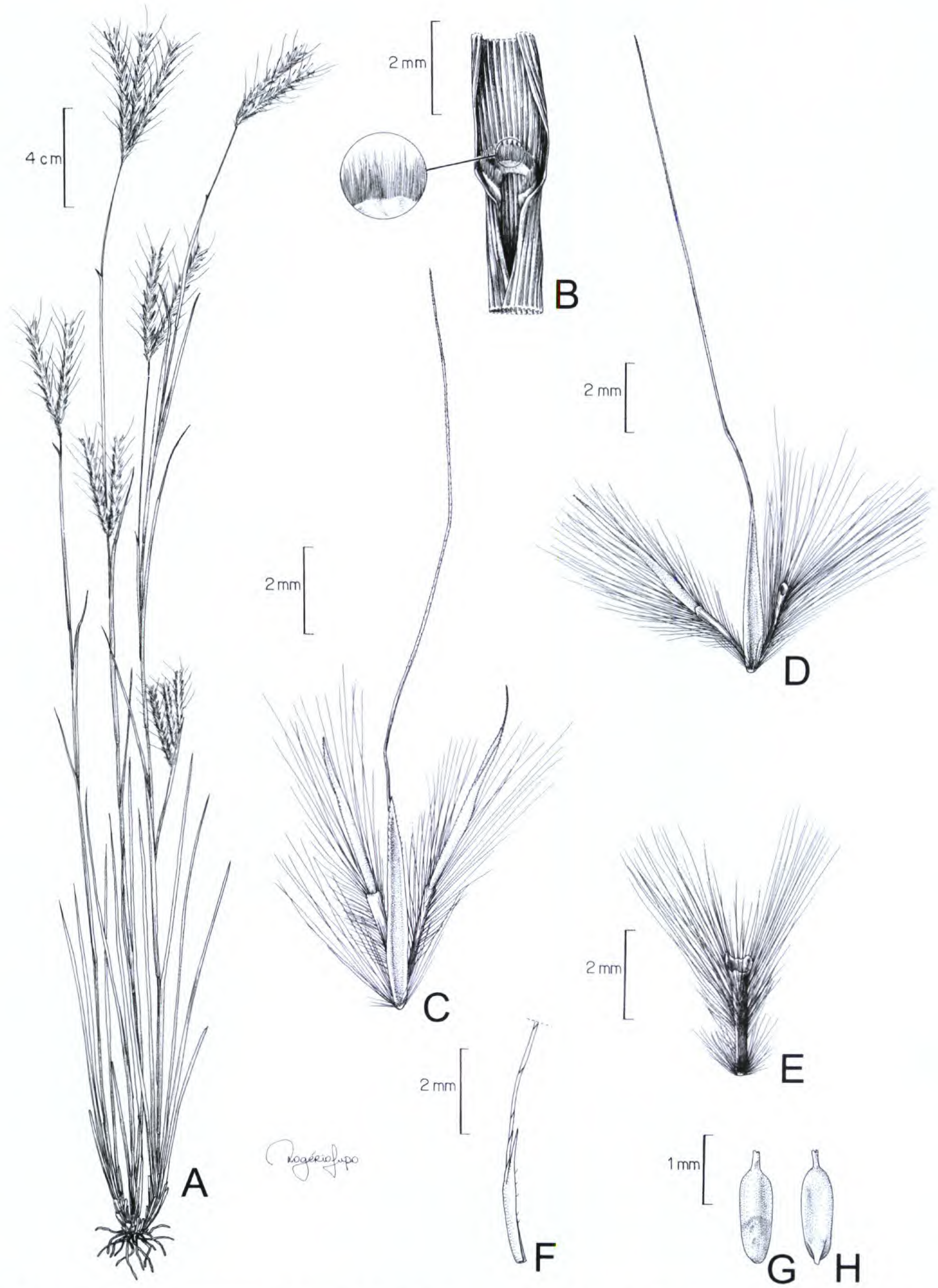

Figure 1. *Andropogon brasiliensis* A. Zanin & Longhi-Wagner. —A. Habit. —B. Ligule. —C. Terminal dispersal unit of the flowering branches. —D. Dispersal unit of the mid portion of the flowering branches. —E. Rachis internode. —F. Upper lemma of the sessile spikelet. —G. Caryopsis, dorsal view. —H. Caryopsis, ventral view. Based on *R. C. Forzza et al. 694* (A), *A. B. Joly et al. 1851* (B–F), and *A. M. Giulietti CFSC 7329* (G, H).

nerveless, acute or irregularly denticulate, glabrous or ciliate at the apex. *Lodicules* 2, ca. 0.7 mm long, glabrous; *stamens* 3, anthers 0.7–1.2 mm long, yellow. *Caryopsis* 1.5–1.8 × 2–3 mm. *Pedicellate spikelet* neuter, (2–)3.1–5 × 0.1–0.2 mm, shorter than or as long as the sessile spikelet, always narrower.

Andropogon brasiliensis occurs in "campos rupestres" of the Espinhaço Range as isolated individuals in humid, sandy, and rocky soils. The new species resembles *A. macrothrix* Trinius, but the plants are more delicate, with shorter leaf blades, up to 17 cm long and 2 mm wide. In *A. macrothrix*, the leaf blades are usually more than 2 mm wide and extend up to 38 cm long. Furthermore, *A. macrothrix* has terminal and axillary inflorescences that are more robust, with 2 to 11 flowering branches, and pedicellate spikelets 1.2 × 3.2 mm long, usually shorter than those of *A. brasiliensis*. The ligules of *A. brasiliensis* are membranaceous ciliate, while in *A. macrothrix* the ligules are membranous ciliolate or membranous with an erose apex.

Paratypes. BRAZIL. **Minas Gerais:** Diamantina, região da Bandeira, 12 km de Diamantina, ao sul da rodovia Diamantina–Belo Horizonte, 9–13 July 1977, *A. G. Burman 25* (SP); Jaboticatubas, km 141 ao longo da rodovia Lagoa Santa-Conceição do Mato Dentro–Diamantina, 17 Apr. 1972, *A. B. Joly et al. 1851* (ICN, SP, SPF); Lima Duarte, Serra do Ibitipoca, Pico do Pião, 20 July 1998, *A. Zanin et al. 740* (FLOR), 23 Mar. 1999, *L. G. Rodela 1C–3* (FLOR); Santana do Riacho, km 137 ao longo da Rodovia Belo Horizonte–Conceição do Mato Dentro, s.d., *A. M. Giulietti et al. CFSC 7329* (SPF); São Tomé das Letras, 11 June 1987, *S. C. Pereira & M. H. Lagoa s.n.* (ESAL 7677, IBGE 20138); morro da entrada da cidade, direção Baependi–São Tomé das Letras, 6 Dec. 1997, *A. Zanin & H. M. Longhi-Wagner 673* (FLOR); Tiradentes, 26 June 1986, *S. C. Pereira s.n.* (ESAL 6537).

Andropogon monocladus A. Zanin & Longhi-Wagner, sp. nov. TYPE: Brazil. Brasília, Reserva Ecológica do IBGE, 4 Aug. 1979, *E. P. Heringer et al. 1716* (holotype, IBGE; isotypes, CEN, ICN, SP, UEC). Figure 2.

A. lateralli subsp. *lateralli* affinis, sed ramo florifero unico per spatheolam praedito et plantis robustis 170–250 cm longis distat.

Perennial, caespitose; culms 170–250 cm tall, glabrous; 9 to 10 glabrous nodes. Leaf sheaths longer and/or shorter than the internodes, villous or hirsute; *blades* (22–)50–70 × 0.5–0.7 cm, linear, flat, apex obtuse or abruptly acute, base straight, glaucous and villous or hirsute on both faces, less frequently glabrous, margins scabrous; *ligule* 1–1.2 mm long, membranous ciliolate. *Inflorescence* 2.5–5 cm long, lax, elongated, composed of terminal and axillary inflorescence units, these units with one non-branched flowering branch, usually partially enclosed by the spatheole; peduncle of the inflorescence unit 1.5–6.5 cm long; spatheole 3.5–7 cm long. *Pedicels and rachis internodes* 2.2–3.5 mm long, linear, subequal in length, with hairs shorter than sessile spikelet. *Sessile spikelet* 4.5–5 mm long, monoclinous, castaneous, stramineous or stramineous-vinaceous; *lower glume* 4.5–5 × 1–1.1 mm long, slightly concave, lanceolate, chartaceous, 2-nerved, without intercarinal nerves, without groove, scabrous on the upper third or half of the nerves, margins glabrous, apex bidentate or erose; *upper glume* 3.5–4 × 0.8–1 mm, apiculate, chartaceous, 3-nerved, scabrous on the upper third or half of the central nerve, ciliate on the upper half of the margins; *lower lemma* 3–4 × 0.7–1 mm, hyaline, 2- to 3-nerved, ciliate on the upper half of the margins; *palea* absent; *upper lemma* 3–3.5 × 0.3–0.6 mm, perfect stramineous or stramineous hyaline, 1- to 3-nerved, glabrous on the margins; apex bifid on the upper third or fifth, awned, awn 8–9 mm long; *palea* 0.8–1.2 × 0.6 mm, hyaline, nerveless, irregularly dentate, glabrous. *Lodicules* 2, ca. 0.8 mm long, glabrous; *stamens* 3, anthers 0.6–1 mm long, yellow. *Caryopsis* 2–3 × 0.8 mm. *Pedicellate spikelet* usually staminate, rarely neuter in the same plant, neuter spikelet 3–3.5 × 0.2 mm; staminate spikelets 4.5–5.5 mm long, somewhat longer than the sessile spikelet, stramineous or stramineous-vinaceous, awnless; *lower glume* 4.5–5.5 × 1–1.2 mm, apiculate or erose, chartaceous, 5-nerved, scabrous on the upper half or third, especially on the nerves, glabrous on the margins; *upper glume* 4 × 1.5 mm, chartaceous, 3-nerved, erose, sparsely scabrous, especially on the nerves, glabrous or ciliate on the margins; *lower lemma* 3.5–4.2 × 1.2 mm, hyaline or hyaline-vinaceous, 1-nerved, ciliate on the upper half of the margins; *palea* absent; *upper lemma* 2.8–3.5 × 0.6–1 mm, hyaline, 1-nerved, ciliate on the upper half of the margins; *palea* 0.6 × 0.5 mm, hyaline, nerveless, irregularly dentate, glabrous. *Lodicules* 2, ca. 0.7 mm long, glabrous; *stamens* 3, anthers 2–2.5 mm long, yellow.

Andropogon monocladus occurs in marshes of the "cerrado," in central Brazil and less frequently in the state of Bahia, also in marshes. The new species resembles *A. lateralis* Nees subsp. *lateralis* due to its well-developed and staminate pedicellate spikelets with the lower glume of the sessile spikelet slightly concave, without nerves or grooves between the keels. *Andropogon lateralis* subsp. *lateralis* differs by always having two or more flowering branch-

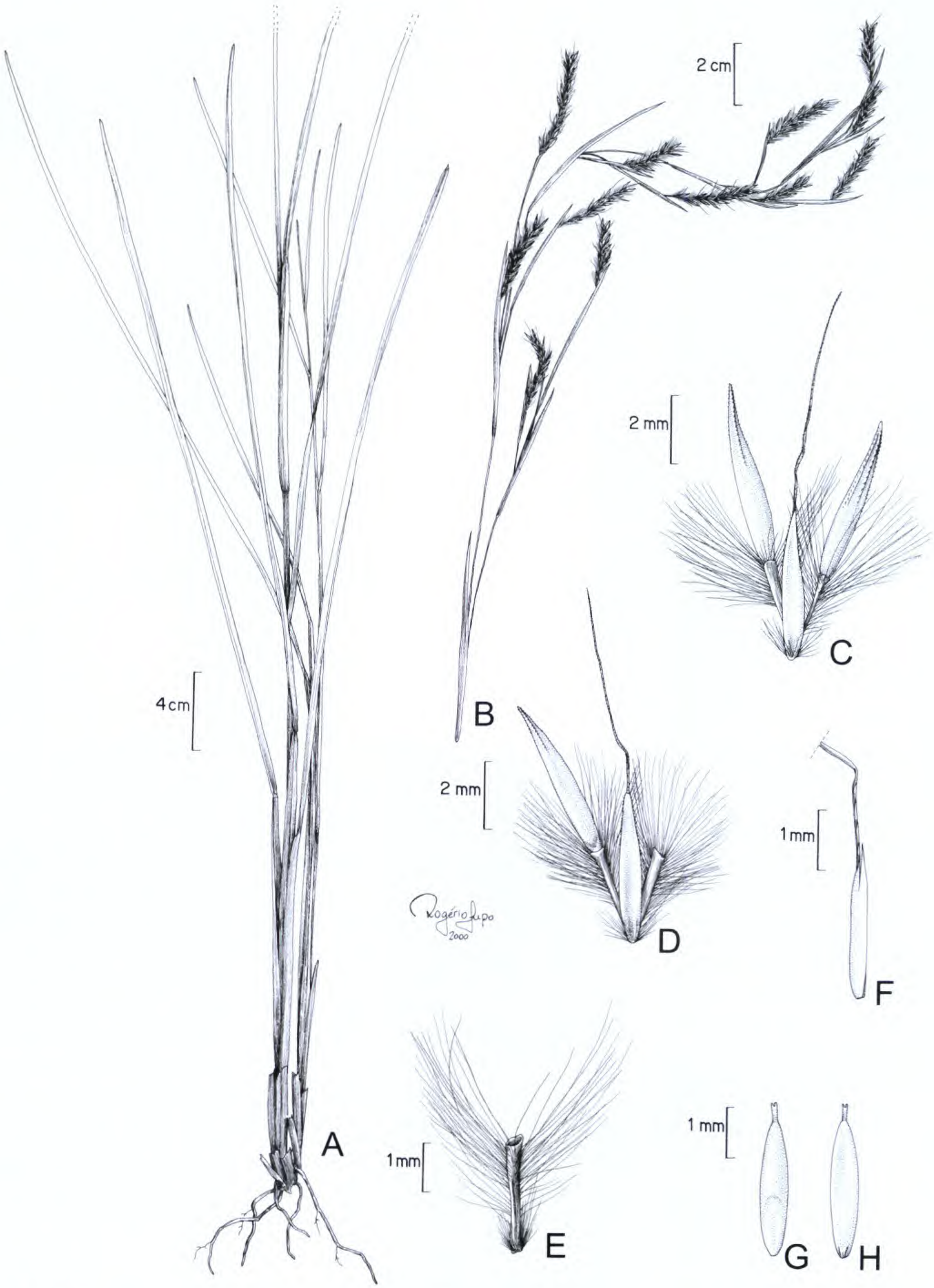

Figure 2. *Andropogon monocladus* A. Zanin & Longhi-Wagner. —A. Flowering culm, basal portion. —B. Flowering culm, apical portion. —C. Terminal dispersal unit of the flowering branches. —D. Dispersal unit of the mid portion of the flowering branches. —E. Rachis internode. —F. Upper lemma of the sessile spikelet. —G. Caryopsis, dorsal view. —H. Caryopsis, ventral view. Based on *P. S. Câmara & T. S. Filgueiras 118.*

es in each inflorescence unit and by the plants being smaller. Furthermore, its distribution is primarily in southern Brazil, while *A monocladus* occurs in central Brazil.

Paratypes. BRAZIL. **Bahia:** Correntina, Fazenda Jatobá, 8 Aug. 1992, *M. A. Silva et al. 1606* (IBGE). **Distrito Federal:** Brasília, Cristo Redentor, 15 Jan. 1991, *P. S. Câmara & T. S. Filgueiras 118* (IBGE); Sobradinho, 27 Sep. 1965, *H. S. Irwin et al. 8734* (US, foto). **Goiás:** Jataí, 30 July 1956, *A. Macedo 4617* (IAC); Municipality not specified, s.d., Fazenda da Vargem, *Glaziou 22366* (K, W).

Andropogon ingratus Hackel var. **hirsutus** A. Zanin & Longhi-Wagner, var. nov. TYPE: Brazil. Bahia: Mun. Abaíra, Catolés de Cima, 23 Mar. 1999, *A. Zanin 786* (holotype, SPF; isotype, FLOR). Figure 3.

Ab *A. ingrato* var. *ingrato* vaginis, laminis et spatheolis hirsutis differt.

Perennial, culms 50–110 cm tall. Leaf sheaths hirsute; *blades* 5–35 × 0.15–0.6 cm, glaucous on both faces, hirsute, especially on abaxial face, margins scabrous. *Inflorescence* 4–9 cm long, lax, elongated, composed of terminal and axillary inflorescence units, these units with 2 to 3(4) non-branched flowering branches. *Pedicels and rachis internodes* linear or subclavate, with hairs usually reaching the same length or twice the length of the sessile spikelet, less commonly shorter. *Sessile spikelet* 5–7 mm long, monoclinous; *lower glume* 4- to 7-nerved, slightly concave, with 2 to 5 intercarinal nerves, without groove; *upper lemma* 3–4 × 0.5–1 mm, stramineous hyaline, 3-nerved, apex bifid on the upper half or third, awned, awn 8–24 mm long; *stamens* 3, anthers 1.2–1.9 mm long, yellow. *Caryopsis* 2.5 × 0.6 mm. *Pedicellate spikelet* staminate or staminate and neuter, rarely only neuter in the same plant, the neuter spikelet 3.5–5.5 × 0.5–0.6 mm; staminate spikelets 4.2–7.2 mm long, shorter or longer than the sessile one; *stamens* 3, anthers 1.2–1.8 mm long, yellow.

Andropogon ingratus var. *hirsutus* occurs in high-altitude cerrado of Chapada Diamantina, Bahia, with one collection from Pernambuco.

The species *Andropogon ingratus* belongs to a group of species occurring in Brazil that are delicate and small in size, reaching only to 110 cm in height. The leaves are completely glaucous, and the flowering branches of the inflorescence units usually have dense, white hairs. The presence of 2 to 5 nerves between the keels of the lower glume of the sessile spikelet is a striking feature of this species. These nerves sometimes are only conspicuous on the upper third or half of the glume, but are always present. The pedicellate spikelets are usually staminate, or staminate and neuter in the same plant, less frequently only neuter. Most of the studied material of *A. ingratus* var. *ingratus* showed leaves and spatheoles completely glabrous. Conversely, *Andropogon ingratus* var. *hirsutus* has hirsute sheaths and leaf blades (the latter on both faces), as well as the spatheoles, with long and snow-white hairs, making the plants stand out among the vegetation.

Paratypes. BRAZIL. **Bahia:** Abaíra, 17 km da cidade em direção a Catolés, 22 Mar. 1999, *A. Zanin et al. 784* (SPF); Jussiape, estrada para Ibicoara, próximo ao Morro Branco, 20 Mar. 1999, *A. Zanin et al. 778* (SPF). **Pernambuco:** Cachoeirinha, 21 Aug. 1969, *E. C. Tenório 69–880* (IPA).

Andropogon bogotensis (Hackel) A. Zanin & Longhi-Wagner, comb. et stat. nov. Basionym: *Andropogon incanus* Hackel var. *bogotensis* Hackel, in A. DC. & DC., Monogr. Phan. 6: 433. 1889. TYPE: Colombia. Apiai: Llano de S. Martin, *Karsten s.n.* in h. Vind. (holotype, W). Figure 4.

Andropogon multiflorus Renvoize, Gram. Bolivia: 596. 1998. Syn. nov. TYPE: Bolivia. La Paz: Iturralde, *Haase 1* (isotype, K).

Andropogon bogotensis has been collected in Brazil, Bolivia, and Colombia. In northern Bolivia, it occurs in the humid savanna of Beni and La Paz (Renvoize, 1998). In Colombia, it occurs in humid areas of the llanos de San Martín, near Bogotá. In Brazil, it has only been found in Minas Gerais, also in low humid areas and on the banks of small streams.

Hackel (1889) described *A. bogotensis* as a variety of *A. incanus* Hackel (= *A. lateralis* Nees) with densely branched inflorescences on the upper nodes of the culms, and awnless, sessile spikelets. Renvoize (1998: 596) described *A. multiflorus* based on the same characteristics, referring to the "spiculis sessilis muticis et inflorescencia ramosissima." There is no doubt that the two taxa are the same. For this reason, we synonymize *A. multiflorus* and propose a new combination, *A. bogotensis*, extending its known distribution to Brazil.

Andropogon bogotensis resembles *A. lateralis* subsp. *lateralis* in the height of the plant, the many axillary inflorescences in the flowering culms, hairiness, the number of flowering branches in the inflorescence unit, and leaf blades glaucous on the adaxial face. However, in *A. bogotensis* the pedicellate spikelets are, for the most part, reduced in size and sterile, with few staminate pedicellate

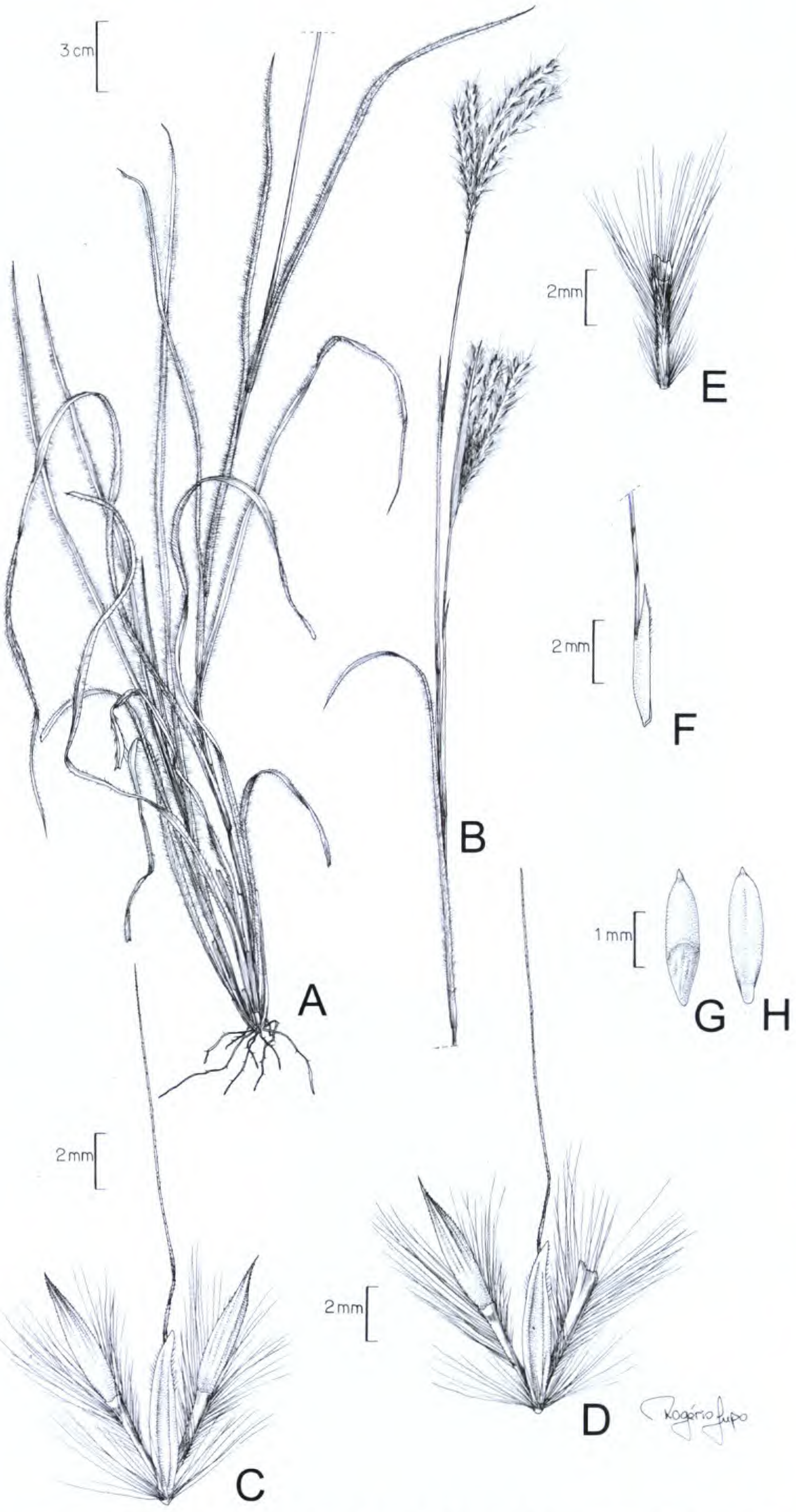

Figure 3. *Andropogon ingratus* Hackel var. *hirsutus* A. Zanin & Longhi-Wagner. —A. Flowering culms, basal portion. —B. Flowering culms, apical portion. —C. Terminal dispersal unit of the flowering branches. —D. Dispersal unit of the mid portion of the flowering branches. —E. Rachis internode. —F. Upper lemma of the sessile spikelet. —G. Caryopsis, dorsal view. —H. Caryopsis, ventral view. Based on *A. Zanin et al. 786.*

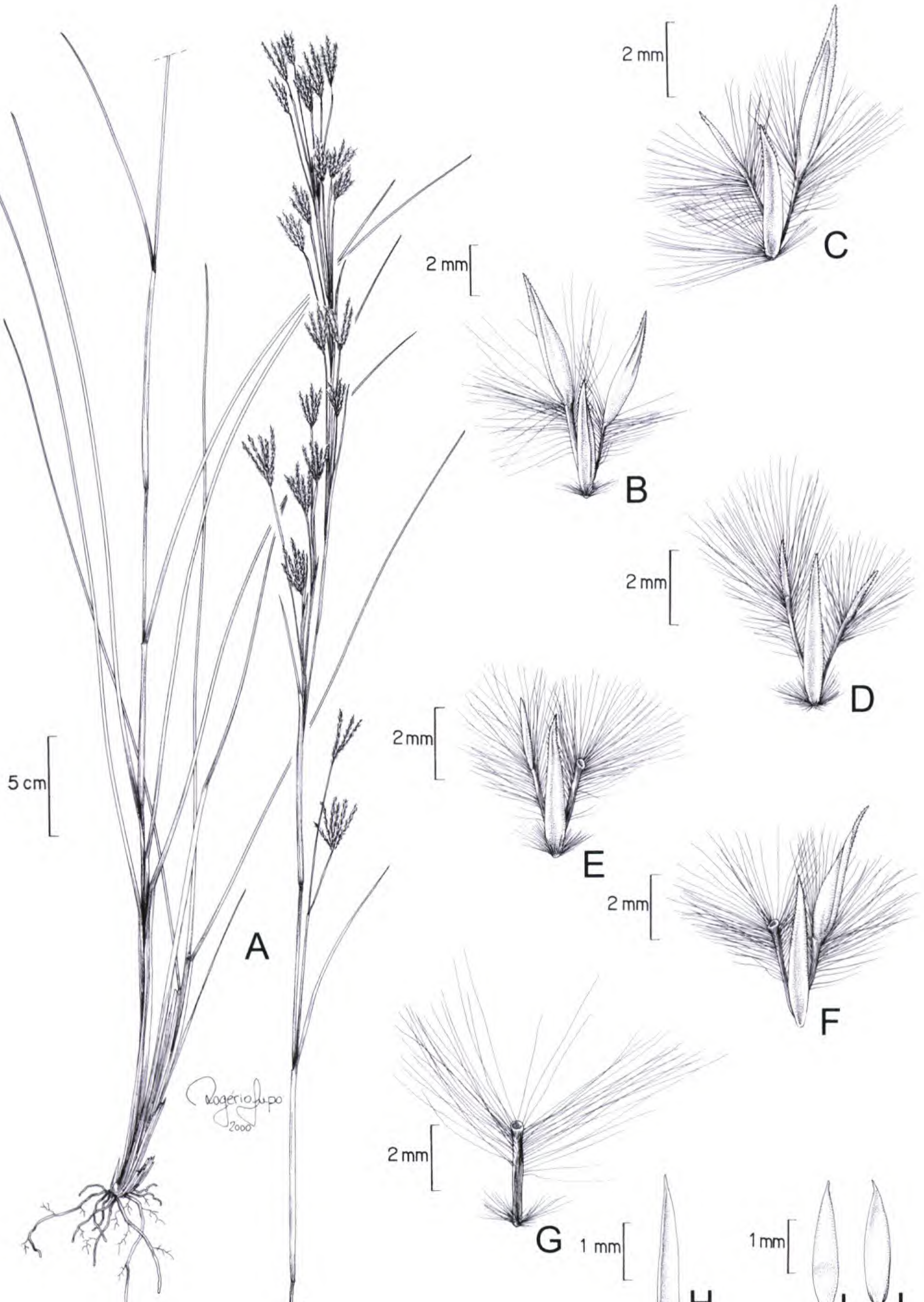

Figure 4. *Andropogon bogotensis* (Hackel) A. Zanin & Longhi-Wagner. —A. Flowering culm, basal and apical portion. —B. Terminal dispersal unit of the flowering branches showing two developed pedicellate spikelets. —C. Terminal dispersal unit of the flowering branches showing one well-developed and one rudimentary pedicellate spikelet. —D. Terminal dispersal unit of the flowering branches with two rudimentary pedicellate spikelets. —E. Dispersal unit of the mid portion of the flowering branches with one rudimentary pedicellate spikelet. —F. Dispersal unit of the mid portion of the flowering branches with one well-developed pedicellate spikelet. —G. Rachis internode. —H. Upper lemma of the sessile spikelet. —I. Caryopsis, ventral view. —J. Caryopsis, dorsal view. Based on *A. Zanin & A. C. Araújo 719* (A–H) and *A. Chase 10443* (I, J).

spikelets intercalated along and at the apex of the flowering branches, unlike *A. lateralis* subsp. *lateralis*, where the pedicellate spikelets are always well developed and staminate. In the holotype and most specimens of *A. bogotensis*, the sessile spikelets are awnless or with an awn 1 mm long. However, in specimens *A. G. Burman 392*, *A. Silveira 1842*, and *Macedo 4908*, the awns were observed to be 2–10 mm long combined with awnless spikelets in the same inflorescence. The muticous sessile spikelet and the smaller pedicellate spikelets give the inflorescence of *A. bogotensis* a much more delicate aspect than in *A. lateralis* subsp. *lateralis*.

Specimens examined. BRAZIL. **Minas Gerais:** Diamantina, Serra de Santo Antônio, 27–30 Dec. 1929, *A. Chase 10443* (VIC), 19 Jan. 1984, *T. S. Filgueiras & A. G. Burman 1086* (IBGE); 12 km de Diamantina, ao sul da rodovia Diamantina–Belo Horizonte, 9–13 July 1977, *A. G. Burman 41* (SP); estrada de Sousa até São João da Chapada, 1 Apr. 1980, *A. G. Burman 549* (SP); estrada Datas–Diamantina, BR 259, km 590, 10 Dec. 1997, *A. Zanin & A. C. Araújo 716* (FLOR, SPF); saída da cidade, em direção a Biribiri, 11 Dec. 1997, *A. Zanin & A. C. Araújo 719* (FLOR, SPF); Lavras Novas, Serra de Itatiaia e Serra de Lavras Novas, 6 Sep. 1978, *A. G. Burman 392* (SP); São João Del Rei, próximo a São João Del Rei, Oct. 1896, *A. Silveira 1842* (R); Uberlândia, Estação de Sucupira, 24 Jan. 1957, *A. Macedo 4908* (IBGE, SP).

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A New Species and a Nomenclatural Change in *Graptopetalum* (Crassulaceae)

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ABSTRACT. *Graptopetalum glassii* from Colima, Mexico, is described and illustrated. It is closely related to *G. pentandrum*, differing in being smaller and in having a herbaceous habit and a larger number of oblanceolate pale green leaves. *Graptopetalum pentandrum* subsp. *superbum* is raised to species rank. Characters that support the change of status are a larger size of the plants, a squamose surface of the stem, a pink-violet color of the rosette, oblong-obovate leaves, and a profusely branched inflorescence.

RESUMEN. *Graptopetalum glassii* de Colima, México, es descrita e ilustrada. Está cercanamente relacionada con *G. pentandrum*; sin embargo, difiere en poseer un menor tamaño, un hábito herbáceo con un mayor número de hojas oblanceoladas de color verde mas pálido. *Graptopetalum pentandrum* subsp. *superbum* es elevada a nivel de especie. Caracteres que apoyan el cambio de estatus son un tamaño mas grande, una superficie del tallo escamosa, un color rosa-violeta de la roseta, hojas oblongo-obovadas y un mayor número de ramas en la inflorescencia.

Key words: Colima, Crassulaceae, *Graptopetalum*, Mexico.

Graptopetalum Rose (Crassulaceae) includes approximately 19 species from Arizona, U.S.A., to Oaxaca, Mexico, found in inaccessible places in semiarid vegetation over rocky hills or walls of ravines, from sea level to 7500 ft. Only a few species have wide distribution, such as *G. pachyphyllum* Rose and *G. rusbyi* (Greene) Rose, while most of the species are restricted to specific mountains or ravines. For example, *G. mendozae* Glass & Cházaro grows in the foothills of small mountains in the north of Veracruz, Mexico (Glass & Cházaro, 1997), and *G. marginatum* Kimnach & Moran is known only from the north of Tepic in Nayarit, Mexico (Kimnach & Moran, 2002).

Plants of *Graptopetalum* are characterized by caulescent or acaulescent rosettes. The caulescent species are pendent or bushy, and the leaves are thick. The inflorescence is lateral and the flowers usually have a fetid odor; petals are pale, erect, and fused in the lower half and rotate in the apex, where they have red to brown dots often forming bands across the petals. The stamens are initially erect; after anthesis they become strongly recurved (Uhl, 1970).

In 1995 Charles Glass and Mario Mendoza found a population of a *Graptopetalum* species restricted to a gypsum wall on the Pacific slopes of Mexico in the state of Colima. Due to its distinctive characters, we describe it here as *G. glassii*. This new

species and the new combination that follow are the result of a phylogenetic study of the genus *Graptopetalum*, which is currently in preparation by the first author. The names are here published separately to make them immediately available for use.

Graptopetalum glassii Acevedo-Rosas & Cházaro, sp. nov. TYPE: Mexico. Colima: Municipio de Ixtlahuacán, Carretera libre de Ixtlahuacán a Colima, justo enfrente del señalamiento del km 21 de la autopista Colima–Tecomán, sobre una pared de suelo yesoso con exposición NE, 410 m, 12 ene. 2000, *R. Acevedo, M. Cházaro & J. A. Machuca 1724* (holotype, XAL; isotypes, MO, NY). Figure 1.

Graptopetalo pentandro cognatum. Plantae perennes caespitosae. Caules maximam partem decumbentes breves vel plantae acaules. Rosula ejus *G. pentandri* minor sed foliis pluribus munita congestaque. Folia oblanceolata vel late oblanceolata, albo-viridia. Inflorescentia sub cymae compositae formam; flores pentandri; petala triangulari-lanceolata-acuta; calyx cupuliformis; gynoecium obovatum.

Plants perennial, caespitose, forming compact clusters; *stem* mostly decumbent, smooth, short or the plants stemless; suberect at first, then pendent, to 55 mm long, 3–5 mm thick; at first nearly white-glaucous, later red-brown-glaucous; mostly caespitosely branching by ascending (when young) and pendent (with age) slender stems from below rosette. Rosettes 20–30(40) mm diam. when mature, with 30 to 40(50) crowded leaves; *leaves* white-green to pale blue-green to yellow-green with palest rosy blush, especially in youngest leaves and with exposure to more intense light, glabrous, slightly glaucous, ascending-erect when young, later the apical ones ascending-erect and the basal ones expanding, 13–16(20) × 8–12 mm, ca. 2–5 mm thick, inner surface slightly concave, outer surface markedly convex, vaguely keeled in upper 2–4 mm, oblanceolate to broadly oblanceolate; apex somewhat acute or slightly apiculate, light green. *Inflorescence* a compound cyme, generally 6–12 cm high; unbranched or with 1 or 2(3) simple or bifurcate branches; peduncle 2.5–8 cm tall, 2–3.5 mm thick, smooth, light green, pink or red-tinged, with 16 to 18 bract leaves, soon deciduous, similar to rosette leaves but ovate rather than oblanceolate, diminishing markedly in size, 7–10 × 6–7 mm, 2.5 mm thick, bracteoles mostly elliptic to lanceolate, 1.5–3 × 1–1.5 mm; *flower* buds about 9 mm long, typically 5-merous; *calyx* cup-shaped, 4 mm high, sepals 5, gray-green, tips 3 mm long; *corolla* ca. 8–9 mm long when unopened, 12–14 mm wide when expanded, yellow-white marked with red, flecks and partial banding toward the tips, the tips nearly solid red, petals 5 (rarely 6), 3.5 mm wide near base, triangular-lanceolate, acute, united for ca. 2.7 mm, rotate in the distal half; *stamens* 5, antesepalous, at first erect, after anthesis strongly reflexed between the petals, 6–7 mm long, ca. 0.4 mm wide, base adnate to corolla tube, filaments white, the apical half pink or red dotted, anthers with gray-yellow pollen; *nectar glands* 5, yellow, 0.3 mm tall, 0.5 mm wide, 0.3 mm thick, somewhat reniform, the inner face strongly concave, the external convex; *gynoecium* obovate, green-yellow, reddened apically, ca. 6–6.5 mm long, 3–3.5 mm thick, the styles 1 mm long or less.

Distribution and ecology. Known only from the type locality at an elevation of 410 m, where the plant occurs in tropical deciduous forest. *Graptopetalum glassii* grows on gypsum slopes of hills.

Phenology. *Graptopetalum glassii* flowers from late February to April or early May. Flowers produce a disagreeable fetid odor.

Etymology. The species is named after Charles Glass (1934–1998), who collected plants of the new taxon for the first time. Mr. Glass worked as the Curator of Plants for *Cante, A.C.* (a non-governmental organization), a small botanical garden located in San Miguel de Allende, Guanajuato, Mexico, where he studied succulent plants such as Cactaceae and Crassulaceae. Mr. Glass carried out many field trips to remote and interesting places of Mexico, where he found and described new taxa of these groups.

Graptopetalum glassii differs from *G. pentandrum* in its shorter herbaceous habit, caespitose growth, a smaller size of the stem, rosette, and leaves, and a shorter inflorescence (Table 1). *Graptopetalum glassii* can be recognized in the field among other known species of the genus by its beautiful little light green and dense rosettes, its shorter and slender stems, and the numerous conglomerate leaves (more than 40); this discovery also represents the third record in the genus having haplostemonous flowers.

Plants of *Graptopetalum glassii* are sold as *G. sotoi*; M. Cházaro and C. Glass were planning to publish it. Figure 1 depicts a cultivated plant, which is more branched and robust than wild plants. Table 1 summarizes the main differences among *Graptopetalum glassii* and the closely related species *G. pentandrum* and *G. superbum*, and is based on our own observations.

Paratype. MEXICO. **Colima:** near La Salada, approx. 25 km S of Colima on a steep and shaded gypsum slope, 29 Dec. 1995, *C. Glass & M. Mendoza 8910* (*Cante, A.C.*).

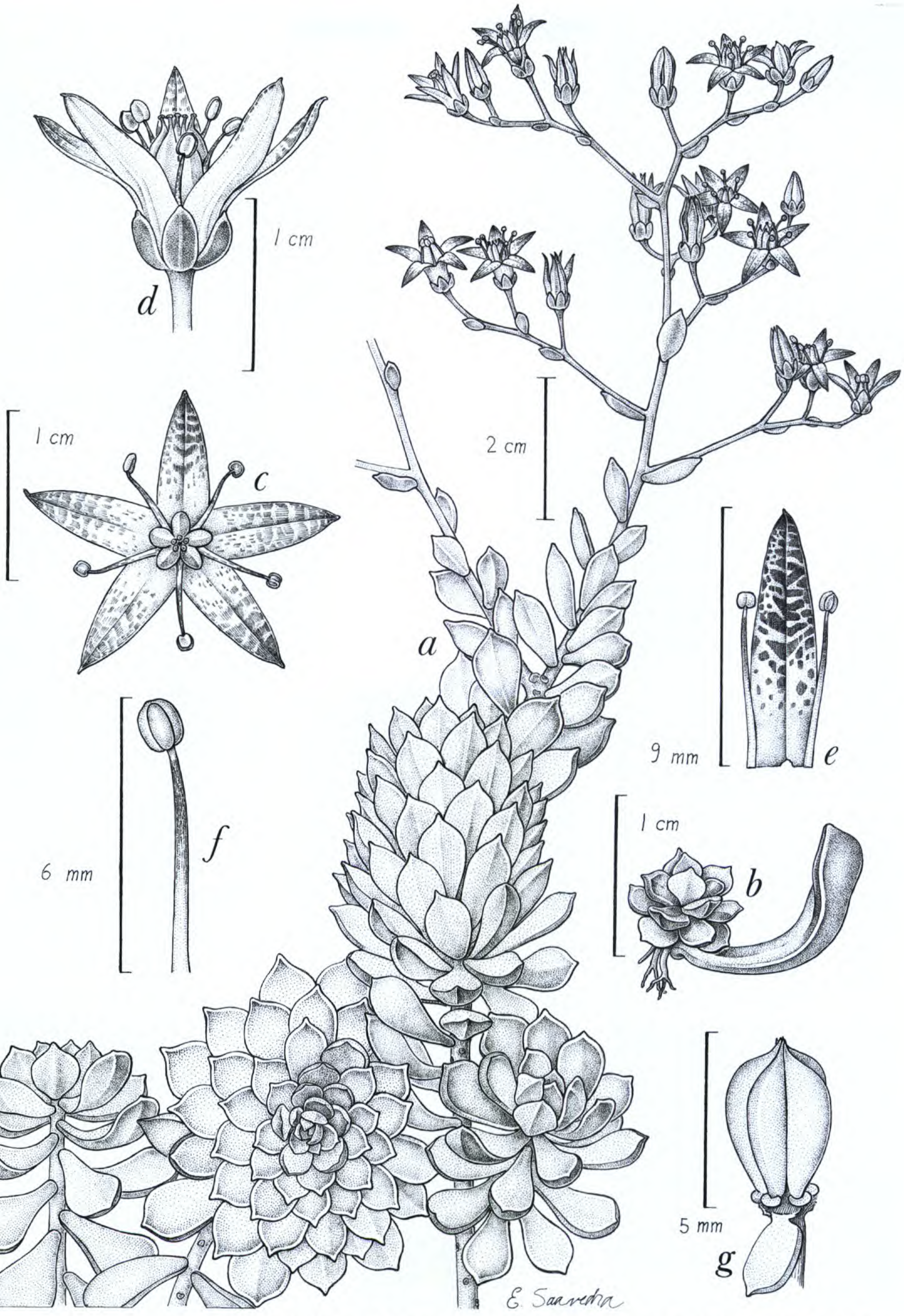

Figure 1. *Graptopetalum glassii* Acevedo-Rosas & Cházaro. —a. Habit. —b. Propagation of plant by leaf cutting. —c. Front view of flower. —d. Lateral view of flower. —e. Petal and stamens. —f. Stamen. —g. Gynoecium with nectary scales. Based on living collection established at "Clavijero" botanical garden in Xalapa, Veracruz, Mexico (acc. no. 2003-16), holotype: *R. Acevedo et al. 1724* (XAL).

Table 1. Distinguishing characters of *Graptopetalum glassii* and its closest relatives.

	G. glassii	*G. pentandrum*	*G. superbum*
Habit	herbaceous	suffrutex	suffrutex
Plant	caespitose	caespitose-ramose	ramose
Size	16 cm	40 cm	80 cm
Stem surface	smooth	smooth	squamose
Stem diameter	3–5 mm	3–6 mm	10–12 mm
Leaf form	oblanceolate	obovate	oblong-obovate
Leaf color	blue-green to white-green	blue-green to white-blue	gray-blue to pink-violet
Leaf length	13–20 mm	20–40 mm	40–55 mm
Rosette diameter	40 mm	60 mm	90 mm
Number of leaves per rosette	30–40	15–30	12–20
Inflorescence length	6–12 cm	20–35 cm	30–40 cm
Number of branches per inflorescence	1–2	3–4	12–15

Graptopetalum superbum (Kimnach) Acevedo-Rosas, stat. nov. Basionym: *Graptopetalum pentandrum* Moran subsp. *superbum* Kimnach, Cact. Succ. J. (Los Angeles) 59: 142. 1987. TYPE: Cultivated. Mexico. La Barca, near Guadalajara, the native locality unknown, *Avina s.n.*, HBG acc. no. 49307 (holotype, HNT sheet #6392).

Graptopetalum superbum was described as a subspecies of *G. pentandrum* by Kimnach (1987). *Graptopetalum superbum* is distinguished from *G. pentandrum* by its larger size, a squamose surface of the stem, a pink-violet color of the rosette, leaves oblong-obovate, a profusely branched inflorescence (see Table 1), and different chromosome number (*G. superbum* $n = 64$, *G. pentandrum* $n = 32$, according to Uhl (in Kimnach, 1987)).

Morphological cladistic analyses indicate that *Graptopetalum glassii*, *G. pentandrum*, and *G. superbum* are closely related and belong to a small group (Acevedo et al., in press) that occurs in the area of Nueva Galicia in western Mexico. Among the characters they share are five stamens in a single whorl (haplostemonous flowers) instead of ten in two whorls, which the rest of the species in the genus have. Among Crassulaceae, only some genera of Sedoideae and the representatives in the Crassuloideae include haplostemonous species, and all are from the Old World (Berger, 1930).

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Transfer of Most North American Species of *Arabis* to *Boechera* (Brassicaceae)

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ABSTRACT. Based on extensive molecular, cytological, and morphological studies, most of the North American species of *Arabis* (Brassicaceae) are recognized herein as members of the genus *Boechera*. Morphological differences between the two genera are discussed, and species formerly placed in *Arabis* and not included here in *Boechera* are assigned to other genera. Thirty-two new combinations in *Boechera* are proposed: *B. bodiensis* (Rollins) Al-Shehbaz, *B. breweri* (S. Watson) Al-Shehbaz, *B. canadensis* (L.) Al-Shehbaz, *B. constancei* (Rollins) Al-Shehbaz, *B. cusickii* (S. Watson) Al-Shehbaz, *B. dispar* (M. E. Jones) Al-Shehbaz, *B. falcifructa* (Rollins) Al-Shehbaz, *B. fruticosa* (A. Nelson) Al-Shehbaz, *B. glaucovalvula* (M. E. Jones) Al-Shehbaz, *B. hastatula* (Greene) Al-Shehbaz, *B. hirshbergiae* (S. Boyd) Al-Shehbaz, *B. hoffmanii* (Munz) Al-Shehbaz, *B. inyoensis* (Rollins) Al-Shehbaz, *B. johnstonii* (Munz) Al-Shehbaz, *B. koehleri* (T. J. Howell) Al-Shehbaz, *B. laevigata* (Muhlenberg ex Willdenow) Al-Shehbaz, *B. missouriensis* (Greene) Al-Shehbaz, *B. ophira* (Rollins) Al-Shehbaz, *B. parishii* (S. Watson) Al-Shehbaz, *B. patens* (Sullivant) Al-Shehbaz, *B. perstellata* (E. Braun) Al-Shehbaz, *B. pinzlae* (Rollins) Al-Shehbaz, *B. platysperma* (A. Gray) Al-Shehbaz, *B. pygmaea* (Rollins) Al-Shehbaz, *B. rectissima* (Greene) Al-Shehbaz, *B. repanda* (S. Watson) Al-Shehbaz, *B. rigidissima* (Rollins) Al-Shehbaz, *B. rollei* (Rollins) Al-Shehbaz, *B. shortii* (Fernald) Al-Shehbaz, *B. stricta* (Graham) Al-Shehbaz, *B. subpinnatifida* (S. Watson) Al-Shehbaz, and *B. tiehmii* (Rollins) Al-Shehbaz. Three recently described species, *Arabis calderi* G. A. Mulligan, *A. murrayi* G. A. Mulligan, and *B. glareosa* Dorn, are reduced to synonymy of *B. divaricarpa* (A. Nelson) A Löve & D. Löve, *B. lyallii*, and *B. gunnisoniana* (Rollins) W. A. Weber, respectively.

Key words: *Arabidopsis*, *Arabis*, *Boechera*, Brassicaceae, *Pennellia*, *Turritis*.

As traditionally delimited by recent North American botanists (e.g., Hopkins, 1937; Rollins, 1941, 1993b; Mulligan, 1996), the genus *Arabis* L. (Brassicaceae) was rather broadly circumscribed to include species now placed in *Arabidopsis* Heynhold, *Boechera* A. Löve & D. Löve, *Pennellia* Nieuwland, and *Turritis* L. (see below). Several European botanists also adopted such a broad concept. For example, Busch (1939) included in *Arabis* species now placed in *Alyssopsis* Boissier; *Arabidopsis*; *Crucihimalaya* Al-Shehbaz, O'Kane & R. A. Price; *Neotorularia* Hedge & J. Léonard; *Rhammatophyllum* O. E. Schulz; and *Turritis*. By contrast, the recent treatment of *Arabis* by Jones and Akeroyd (1993) included species now assigned to *Arabidopsis*, *Diplotaxis* DC., *Fourraea* Greuter & Burdet, and *Turritis* (author's compilation). All of the above authors delimited *Arabis* exclusively on a combination of latiseptate siliques (fruits flattened parallel to the septum), branched trichomes, and accumbent cotyledons. However, this combination of characters evolved independently many times within the Brassicaceae (Appel & Al-Shehbaz, 2002), and it characterizes some or all species of the ten genera above (minus *Diplotaxis*), as well as those of *Aplanodes* Marais (South Africa), *Aubrieta* Adanson (Europe), *Desideria* Pampanini (central Asia and Himalayas), *Draba* L. (several Asian species), *Eremobium* Boissier (northern Africa, Middle East), *Erysimum* L. (some Eurasian species), *Eurycarpus* Botschantzev (Himalayas), *Lepidostemon* J. D. Hooker & Thomson (Himalayas), *Matthiola* R. Brown (Africa, Eurasia), *Pachycladon* J. D. Hooker (New Zealand and Tasmania), *Pennellia* (some North American members), *Phoenicaulis* Nuttall (U.S.A.), *Sibara* Greene (North America), *Sisymbriopsis* Botschantzev & Tzvelev (central Asia), *Smelowskia* C. A. Meyer ex Ledebour (Far East representatives), and *Stevenia* Adams & Fischer (eastern and central Asia).

Rollins (1993b) recognized 80 North American species in *Arabis*, of which 24 were further divided into 40 varieties, while Mulligan (1996) accepted 30 species and 6 varieties in Alaska, Canada, and Greenland. As shown below, extensive molecular studies on members of North American *Arabis* clearly indicate that the genus, as circumscribed

by Rollins (1993b) and Mulligan (1996), is polyphyletic and represents a heterogeneous assemblage of four genera: *Arabidopsis*, *Boechera*, *Pennellia*, and *Turritis*. First, *Arabis lyrata* L., including *A. media* N. Busch and *A. kamchatica* (Fischer) Ledebour, has been shown by Al-Shehbaz and O'Kane (2002), O'Kane and Al-Shehbaz (1997, 2003), Koch et al. (1999, 2000, 2001), Heenan et al. (2002), and Miyashita et al. (1998) to belong to *Arabidopsis*. Second, *Arabis glabra* (L.) Bernhardi was shown by Koch et al. (1999, 2000, 2001) and Heenan et al. (2002) to be unrelated to *Arabis* and to belong to *Turritis*, as originally treated by Linnaeus (1753) and as accepted in a number of monographic, floristic, and systematic accounts of the family (e.g., Torrey & Gray, 1838; Hayek, 1911; Burdet, 1967; Schulz, 1936; Schultze-Motel, 1986; Zhou et al., 2001; Appel & Al-Shehbaz, 2002). Third, *Arabis microsperma* Rollins and *A. tricornuta* Rollins belong to *Pennellia* (Bailey et al., 2002; Price et al., 2001; Fuentes-Soriano, 2002), a genus most closely related to *Halimolobos* Tausch, *Mancoa* Weddell, *Boechera*, and *Sphaerocardamum* Shauer, and clearly unrelated to *Arabis*. Finally, the bulk of North American *Arabis* is recognized here as *Boechera*.

The genus *Boechera* was segregated from *Arabis* by Löve and Löve (1976) and was said to differ by having a base chromosome number of $x = 7$ instead of $x = 8$. These authors did not provide any morphological characters that otherwise distinguished the two genera. Rollins (in Rollins & Rüdenberg, 1977) strongly disagreed with the splitting of *Arabis* based on chromosome numbers, though he admitted (p. 102) that species with $x = 7$ have "a somewhat different circle of close affinity" from those with $x = 8$, which are related to the Eurasian members of the genus. Weber (1982: 369) concluded that "The difference in basic chromosome number [in *Arabis*] . . . does represent a divergent phylogenetic line, and the genetic barrier that it presents to interbreeding of the units is sufficient justification for thinking in terms of discrete genera."

Several phylogenetic studies (Galloway et al., 1998; Koch et al., 1999, 2000, 2001, 2003; Heenan et al., 2002; O'Kane & Al-Shehbaz, 2003) have clearly demonstrated that *Boechera* is unrelated to *Arabis alpina* L., the type species of *Arabis*, or to the Eurasian and North American species with $x = 8$. Therefore, molecular, cytological, and morphological data (see below) strongly support the recognition of *Boechera* as a genus well-defined from the rest of *Arabis*, hereafter *Arabis* s. str., with $x = 8$. Only about ten native North American species belong to *Arabis* s. str. (Mitchell-Olds, unpublished): *A. aculeolata* Greene, *A. arenicola* (Richardson & Hooker) Gelert, *A. blepharophylla* Hooker & Arnott, *A. hirsuta* L., *A. macdonaldiana* Eastwood, *A. modesta* Rollins (if indeed different from the next species), *A. oregana* Rollins, *A. crusisetosa* Constance & Rollins, *A. furcata* S. Watson, and *A. nuttallii* B. L. Robinson. Chromosome counts based on $x = 8$ are known for all except the last three species, which are retained in this genus on the basis of the nuclear ribosomal DNA ITS region (Mitchell-Olds, pers. comm.), leaf indumentum, and fruit morphology. Whether or not the western North American *A. eschscholtziana* Andrzejowski ex Ledebour should be recognized as a distinct species (Mulligan, 1996), as a variety of *A. hirsuta* (Rollins, 1993b), or as a subspecies or synonym of the latter is a matter of judgment and will be dealt with in a separate paper. With the exclusion of the ten North American species of *Arabis* s. str., as well as those transferred to *Arabidopsis* (*A. lyrata*), *Turritis* (*A. glabra*), and *Pennellia* (*A. microsperma* and *A. tricornuta*), the remaining species assigned to *Arabis* by Rollins (1993b) and Mulligan (1996, 2002) should be segregated as *Boechera*.

A critical comparison of the Eurasian and North American species of *Arabis* s. str. and *Boechera* reveals that there are a number of morphological characters that readily distinguish the two. No species of *Arabis* s. str. has falcate, secund, widely spreading, pendent, or strongly reflexed fruits, but the majority of *Boechera* species have at least one of these aspects of fruit morphology. Species of *Arabis* s. str. have erect, ascending, or divaricate-ascending, straight fruits. Furthermore, no species of *Arabis* s. str. has dendritic, irregularly bifurcate, or sessile trichomes on the leaves, and the vast majority of *Boechera* species have at least one of these trichome types. In *Arabis* s. str., the trichomes are stalked and either forked, 3-rayed, or cruciform, and their rays are almost always unbranched. The present author and Sara Fuentes-Soriano are preparing a detailed atlas of trichome morphology of *Arabis* s.l. A few Eurasian species assigned to *Arabis* have dendritic trichomes, and they are to be transferred to other genera (Al-Shehbaz, unpublished). In species with glabrous leaves, characters of the fruit, seed, or leaf morphology (see below) help in assigning them to either of the two genera.

A few other characters have some limited use in the separation of *Arabis* s. str. and *Boechera*. For example, the fruits in *Arabis* s. str. are generally narrow (often less than 2 mm wide) and always glabrous. Although many species of *Boechera* have narrow and glabrous fruits, several others

have fruits 3–8 mm wide or fruit valves sparsely to moderately pubescent. The seeds in *Arabis* s. str. are uniseriate and either narrowly winged or wingless, just as in a number of *Boechera* species. However, several species of *Boechera* have broadly winged seeds (wing 1–3 mm wide) and/or biseriate seeds.

Weber (1982) indicated that *Arabis* is separated from *Boechera* by having loose, slender root systems (instead of shortly clustered caudices) and large, numerous, and often toothed (instead of smaller, fewer, and entire) leaves. These differences were not recognized by Al-Shehbaz (1988), Rollins (1993b), and Mulligan (1996). A closer examination of the caudex and leaves in *Arabis* s.l. worldwide further shows that the caudex, which is absent in the annual and biennial species, is not useful taxonomically and only the leaves are occasionally helpful in the separation of the two genera.

To my knowledge, *Arabis* s. str. does not include any species with both polyploidy and apomixis. Apomixis in *Arabis* s.l. was first reported by Böcher (1947) in *A. holboellii* and subsequently confirmed in other critical studies (Böcher, 1951, 1954, 1966, 1969). Mulligan (1996) suggested that sexual and apomictic populations are found within *A. columbiana* Macoun, *A. divaricarpa* A. Nelson, *A. drummondii* A. Gray, *A. exilis* A. Nelson, *A. lemmonii* S. Watson, *A. lyallii* S. Watson, *A. microphylla* Nuttall, *A. pinetorum* Tidestrom, and *A. sparsiflora* Nuttall. These species, recognized here as members of *Boechera*, include triploid plants based on $x = 7$, and they exhibit some meiotic irregularities, including univalents, multivalents, and B-chromosomes (Böcher, 1947, 1969; Johnson, 1970; Mulligan, 1964, 1996; Packer, 1964; Rollins, 1993b; Rollins & Rüdenberg, 1971; Roy, 1995; Vorobik, 1985).

Jones and Akeroyd (1993) recognized three species in *Arabis* s.l. with strongly falcate and/or reflexed fruits: *A. laxa* Smith (eastern Europe and southwestern Asia), *A. turrita* L. (central and eastern Europe), and *A. pendula* L. (Eurasia). *Arabis laxa* has long been recognized as *Turritis laxa* (Smith) Hayek in several other floristic works (e.g., Cullen, 1965; Hedge, 1968; Meikle, 1977), and on the basis of overall morphology (e.g., glaucous cauline leaves, creamy white or yellowish flowers, slightly 4-angled fruits) and a chromosome number of $n = 6$ (Maassoumi, 1980), it is perfectly at home in *Turritis*. *Arabis turrita*, with $2n = 16$ (e.g., Burdet, 1967; and numerous subsequent counts), is the only species in the genus with bracteate racemes and fruits to 9 cm long. Molecular studies (Koch et al., 2000, 2001) strongly support the separation of this species to a distinct genus. In addition to its chromosome number of $2n = 21$ (Berkutenko & Gurzenkov, 1976; Berkutenko et al., 1984), *A. pendula* is anomalous in *Arabis* s. str. because it has sessile stellate trichomes with an erect central ray much coarser than the other rays. One might be tempted to place it in *Boechera*, but molecular data (O'Kane & Al-Shehbaz, 2003) place it in a clade well separated from both *Arabis* s. str. and *Boechera*. It may well represent an independent genus, though it is beyond the scope of this paper to deal with it. Another anomalous European *Arabis* recognized by Jones and Akeroyd (1993) is *A. brassica* (Leers) Rauschert, a species with $2n = 14$ (Polatschek, 1966; Burdet, 1967; Titz, 1967; van Loon et al., 1971) often reported as *A. pauciflora* (Grimm) Gracke. However, molecular data (Koch et al., 2001) indicate that this species is unrelated to *Arabis* s. str., and a closer examination of morphology supports Greuter and Burdet (1984) in transferring it to the monotypic *Fourraea* Greuter & Burdet, as *F. alpina* (L.) Greuter & Burdet.

The present account of *Boechera* was prepared during work on the genus for an upcoming volume of the *Flora of North America*, and the new combinations are proposed herein to make the species names available for phylogenetic studies in progress. Of the 40 additional varieties recognized by Rollins in *Arabis* s.l., 35 fall within the present circumscription of *Boechera*. Mulligan (1996) raised 4 of these 35 varieties to the species rank and reduced 9 others to synonymy of other taxa. The status of these infraspecific taxa will be addressed in a subsequent publication following the examination of all types. A key to all species of *Boechera* will be presented when we have a better understanding of the taxa involved, especially the representatives from the Russian Far East.

Under each species of *Boechera*, its synonym in *Arabis* is given regardless whether or not its basionym is in *Arabis*. This is important for comparing the names in *Boechera* with those in Rollins (1993b) and Mulligan (1996). Löve and Löve (1976, 1982), Weber (1982, 1989, 1996), and Dorn (2003) have already transferred several species of North American *Arabis* to *Boechera*, and these are listed below with full information on the type collections because this information was not given by these authors. Types marked "not seen" were compiled from Hopkins (1937), Rollins (1941), and Mulligan (1996).

Boechera beckwithii (S. Watson) Dorn, Brittonia 55: 3. 2003. Basionym: *Arabis beckwithii* S. Watson, Proc. Amer. Acad. Arts 22: 467.

1887. TYPE: U.S.A. Nevada: Quartz Mts., W of Great Salt Lake, *Lieutenant Beckwith s.n.* (lectotype, designated by Rollins (1941: 452), GH).

Watson (1887) cited four syntypes under the original description of *Arabis beckwithii*. Rollins (1941) listed Beckwith's collection as the type, and this was taken as the lectotype.

Boechera bodiensis (Rollins) Al-Shehbaz, comb. nov. Basionym: *Arabis bodiensis* Rollins, Contr. Gray Herb. 212: 113. 1982. TYPE: U.S.A. California: Mono Co., 2 mi. NW of Masonic, 5.9 mi. from Bridgeport-Sweetwater highway, loose soil of old mine, 8100 ft., 3 Aug. 1945, *I. L. Wiggins & R. C. Rollins 536* (holotype, GH; isotypes, DS, GH, UC).

Boechera breweri (S. Watson) Al-Shehbaz, comb. nov. Basionym: *Arabis breweri* S. Watson, Proc. Amer. Acad. Arts 11: 123. 1875. TYPE: U.S.A. California: [Contra Costa Co.], rocky summit of eastern peak of Mt. Diablo, 4 May 1862, *W. H. Brewer 1086* (lectotype, designated by Rollins (1941: 408), GH; isotypes, DS, MO, UC [2], US).

Watson (1875) cited four syntypes under the original description of *Arabis breweri*. Rollins (1941) listed Brewer's collection as the type, and this was taken as the lectotype of the species.

Boechera canadensis (L.) Al-Shehbaz, comb. nov. Basionym: *Arabis canadensis* L., Sp. Pl. 2: 665. 1753. TYPE: lectotype, designated by Reveal in Cafferty & Jarvis (2002: 531), *J. Clayton 400*, left-hand specimen, Herb. Linn. No. 842.12 (LINN; isotype, BM).

Boechera cobrensis (M. E. Jones) Dorn, Vasc. Pl. Wyom. ed. 3: 375. 2001. Basionym: *Arabis cobrensis* M. E. Jones, Contr. W. Bot. 12: 1. 1908. TYPE: U.S.A. Nevada: Elko Co., Cobre, clay hills, 6000 ft., 16 June 1906, *M. E. Jones s.n.* (holotype, POM; isotypes, BM, CAS, MO, POM, US [2]).

Boechera constancei (Rollins) Al-Shehbaz, comb. nov. Basionym: *Arabis constancei* Rollins, Contr. Gray Herb. 201: 5. 1971. TYPE: U.S.A. California: Plumas Co., 7.6 mi. SE of Quincy (at Spring Garden overpass) on road to Blairsden, near rocks on open serpentine, W-SW facing gentle slope, 4100 ft., 11 July 1969, *L. Constance & T. I. Chuang 3875* (holotype, GH; isotype, UC).

Boechera crandallii (B. L. Robinson) W. A. Weber, Phytologia 51: 369. 1982. Basionym: *Arabis crandallii* B. L. Robinson, Bot. Gaz. 28: 135. 1899. TYPE: U.S.A. Colorado: Montrose Co., Cimarron, 7000 ft., 18 May 1898, *C. S. Crandall 6* (holotype, GH; isotype, NY not seen).

Boechera cusickii (S. Watson) Al-Shehbaz, comb. nov. Basionym: *Arabis cusickii* S. Watson, Proc. Amer. Acad. Arts 17: 363. 1882. TYPE: U.S.A. Oregon: Union Co., rocky ridges, early spring 1879, *W. C. Cusick 727* (holotype, GH; isotype, US).

Boechera demissa (Greene) W. A. Weber, Phytologia 51: 370. 1982. Basionym: *Arabis demissa* Greene, Pl. Baker. 3: 8. 1901. TYPE: U.S.A. Colorado: Gunnison Co., Cimarron, stony riverbed, 4 June 1901, *C. F. Baker 16* (holotype, NDG 5264).

Boechera dispar (M. E. Jones) Al-Shehbaz, comb. nov. Basionym: *Arabis dispar* M. E. Jones, Contr. W. Bot. 8: 41. 1898. TYPE: U.S.A. California: Inyo Co., Panamint Mts., Pleasant Canyon, 5500 ft., 6 May 1897, *M. E. Jones s.n.* (holotype, POM; isotypes, MO, POM, US, UTC not seen).

Boechera divaricarpa (A. Nelson) A. Löve & D. Löve, Bot. Not. 128: 513. 1976. Basionym: *Arabis divaricarpa* A. Nelson, Bot. Gaz. 30: 193. 1900. TYPE: U.S.A. Wyoming: Yellowstone National Park, Yellowstone Lake, stony and sandy banks of lake, *A. & E. Nelson 6622* (lectotype, designated by Hopkins (1937: 132), RM; isotype, GH).

Arabis calderi G. A. Mulligan, Rhodora 97: 144. 1996. Syn. nov. TYPE: Canada. British Columbia: Indian River at Mile 34 from Alaska Hwy. on Atlin road, ca. 59°54′N, 133°48′W, open grassy flats on bench above river, 9 June 1960, *J. A. Calder & J. M. Gillett 25180* (holotype, DAO).

Nelson (1900) cited two collections (*6352* and *6622*) in his original description of *Arabis divaricarpa*, but Rollins (1941) indicated that the type is *A. & E. Nelson 6332*, apparently a typographical error. However, Hopkins (1937) was the first to designate a lectotype for the species.

An examination of the holotype of *Arabis calderi* clearly shows that the plant is quite similar to those cited by Mulligan (1996) as *A. divaricarpa* var. *divaricarpa*, including the type collection of *A. pratincola* Greene. There is no single character that supports the maintenance of *A. calderi* as a distinct species, and the trichomes of basal leaves are indistinguishable in the two. As shown by Rollins (1983), *Boechera divaricarpa* (as *Arabis*) is quite

variable in leaf indumentum and fruit orientation, and various populations of this species show morphological tendencies toward one of its closely related species, *B. stricta* (as *A. drummondii*) and *B. holboellii*.

Boechera falcatoria (Rollins) Dorn, Brittonia 55: 3. 2003. Basionym: *Arabis falcatoria* Rollins, Contr. Gray Herb. 212: 106. 1982. TYPE: U.S.A. Utah: Box Elder Co., 3.8 mi. N of Grouse Creek on road to Oakley, Idaho, marble chip rock, 9 June 1981, *R. C. & K. W. Rollins 81259* (holotype, GH; isotypes, GH, LE, RM, RSA, UC).

Boechera falcifructa (Rollins) Al-Shehbaz, comb. nov. Basionym: *Arabis falcifructa* Rollins, Contr. Gray Herb. 212: 112. 1982. TYPE: U.S.A. Nevada: Elko Co., near U.S. Hwy. 93, betw. Thousand Springs & Jackpot, 37 mi. S of Jackpot, rock crevices, sagebrush area on slope of a high ridge, 18 June 1979, *R. C. & K. W. Rollins 79267* (holotype, GH; isotype, MO).

Boechera fecunda (Rollins) Dorn, Brittonia 55: 3. 2003. Basionym: *Arabis fecunda* Rollins, Contr. Gray Herb. 214: 1. 1984. TYPE: U.S.A. Montana: Ravalli Co., big game range E of Corvallis, rocky terrain near sagebrush, 4000 m, 13 June 1976, *Jaculyn Cory 1611* (holotype, MONTU not seen; isotype, GH).

Boechera fendleri (S. Watson) W. A. Weber, Phytologia 51: 370. 1982. Basionym: *Arabis holboellii* var. *fendleri* S. Watson, in A. Gray, Synop. Fl. N. Amer. 1: 164. 1895. TYPE: U.S.A. New Mexico: without locality, 1847, *A. Fendler 27* (holotype, GH; isotypes, MO, NY not seen, UC).

Boechera fernaldiana (Rollins) W. A. Weber, Phytologia 51: 370. 1982. Basionym: *Arabis fernaldiana* Rollins, Rhodora 43: 430. 1941. TYPE: U.S.A. Nevada: Nye Co., Toiyabe Mts., E slope of Toiyabe Dome, among rocks & around sagebrush, 10,000 ft., 13 July 1938, *R. C. Rollins & T. S. Chambers 2520* (holotype, GH; isotypes, DS, MO, UC).

Arabis vivariensis S. L. Welsh, Great Basin Naturalist 46: 263. 1986. *Boechera vivariensis* (S. L. Welsh) W. A. Weber, Phytologia 67: 425. 1989. TYPE: U.S.A. Utah: Uintah Co., Jones Hole, National Fish Hatchery, T3S, R25E, Sec. 1, 6000 ft., 16 May 1979, *S. L. Welsh & E. Neese 18341* (holotype, BRY not seen; isotypes, CAS, GH, RM, RSA, UC, US).

Welsh (1986) indicated that *Arabis vivariensis* differs from *A. fernaldiana* in style length, fruit width, and petal length, and Weber (1989) transferred the species to *Boechera*. Although I have not examined the holotype of *A. vivariensis* at BRY, the study of six isotypes supports Rollins (1993b) in reducing the species to synonymy of *A. fernaldiana*. The differences on which *A. vivariensis* was based are rather minor and show continuous variation.

Boechera fruticosa (A. Nelson) Al-Shehbaz, comb. nov. Basionym: *Arabis fruticosa* A. Nelson, Bot. Gaz. 30: 190. 1900. TYPE: U.S.A. Wyoming: Yellowstone National Park, Undine Falls, dry roadsides, 6 July 1899, *A. & E. Nelson 5681* (holotype, RM; isotypes, GH, MO, NY not seen, US).

Rollins (1983, 1993b) suggested that this species is most likely a variant and possibly synonym of *Arabis divaricarpa*. The two taxa differ considerably in habit as well as the trichomes of basal leaves and merit their recognition as distinct species. The base of *Boechera fruticosa* is somewhat woody and with a few to several stems, and the trichomes are dendritic on minute stalks. By contrast, *B. divaricarpa* is herbaceous and simple at the base, and the trichomes are sessile and often with undivided branches.

Boechera glaucovalvula (M. E. Jones) Al-Shehbaz, comb. nov. Basionym: *Arabis glaucovalvula* M. E. Jones, Contr. W. Bot. 8: 40. 1898. TYPE: U.S.A. California: Inyo Co., Darwin Mesa, Argus Mts., 5000 ft., 8 May 1897, *Marcus E. Jones s.n.* (holotype, POM; isotypes, BM, DS, GH, MO, NY not seen, PH, POM [2], RM, UC [3], US [2], UTC not seen).

Boechera gracilipes (Greene) Dorn, Brittonia 55: 3. 2003. Basionym: *Arabis gracilipes* Greene, Pittonia 4: 193. 1900. TYPE: U.S.A. Arizona: Coconino Co., Flagstaff, May 1893, *N. C. Wilson s.n.* (holotype, NDG 4325).

Boechera gunnisoniana (Rollins) W. A. Weber, Phytologia 51: 370. 1982. Basionym: *Arabis gunnisoniana* Rollins, Rhodora 43: 434. 1941. TYPE: U.S.A. Colorado: Gunnison Co., 6 mi. E of Gunnison, near Saguache Creek, barren rocky knoll, 8000 ft., 21 May 1938, *R. C. Rollins 2090* (holotype, GH; isotypes, BM, DAO, GH, RM, UC).

Boechera glareosa Dorn, Brittonia 55: 1. 2003. Syn. nov. TYPE: U.S.A. Utah: Uintah Co., ca. 14 mi. E of Jensen, 40°21.077′N, 109°04.117′W, 6700 ft. (2040 m), 12 May 2002, *R. D. Dorn 9106* (holotype, RM not seen; isotype, MO).

I have critically examined an isotype of *Boechera glareosa* and compared it with the type collection

and extensive material of *B. gunnisoniana*. There is not a single character that reliably separates the two taxa, especially if the overall variation of the latter is taken into account. The type collection of *B. glareosa* represents the first record of *B. gunnisoniana* from Utah.

Boechera hastatula (Greene) Al-Shehbaz, comb. nov. Basionym: *Arabis hastatula* Greene, Leafl. Bot. Obs. Crit. 2: 79. 1910. TYPE: U.S.A. Oregon: mountains of Imnaha National Forest, 6000 ft., 25 June 1907, *A. W. Sampson & G. A. Pearson s.n.* (holotype, US).

Boechera hirshbergiae (S. Boyd) Al-Shehbaz, comb. nov. Basionym: *Arabis hirshbergiae* S. Boyd, Aliso 17: 203. 1998. TYPE: U.S.A. California: San Diego Co., Cuyamaca Mts., E of Cuyamaca Reservoir along Sunrise Hwy. (S-1), 0.5 mi. SE of junction with Hwy. 79, about 50 ft. N of the road near the Pedro Fages Trail marker, near 33°00′N, 116°30′W, ca. 1400 m, 19 Mar. 1995, *Hirschberg s.n.* (holotype, RSA; isotype, GH).

Boechera hoffmanii (Munz) Al-Shehbaz, comb. nov. Basionym: *Arabis maxima* var. *hoffmanii* Munz, Bull. S. Calif. Acad. Sci. 31: 63. 1932. TYPE: U.S.A. California: Santa Cruz Island, ledges in sea cliffs E of Dick's Harbor, 28 Feb. 1932, *R. Hoffmann 653* (holotype, POM).

Boechera holboellii (Hornemann) A Löve & D. Löve, Bot. Not. 128: 513. 1976. Basionym: *Arabis holboellii* Hornemann, Fl. Danica 11 (Heft 32): tab. 1879. 1827. TYPE: Greenland. "Insulae Disco ad Jacobshavn detexit Inspector Grönland," *C. Holböll s.n.* (holotype, C not seen).

The plate accompanying the original description is superb and shows all the fine details of the flowers, seeds, trichomes, and fruits. *Boechera holboellii* is one of the most complex species in the genus, and Rollins (1993b) divided it into five varieties. Löve and Löve (1976, 1982) treated some of those as *B. collinsii* (Fernald) A. Löve & D. Löve, *B. retrofracta* (Graham) A. Löve & D. Löve, and *B. tenuis* (Böcher) A. Löve & D. Löve, whereas Mulligan (1996) recognized *Arabis boivinii* G. A. Mulligan, *A. exilis* A. Nelson, and *A. pinetorum* Tidestrom.

Boechera inyoensis (Rollins) Al-Shehbaz, comb. nov. Basionym: *Arabis inyoensis* Rollins, Rhodora 43: 457. 1941. TYPE: U.S.A. California: Inyo Co., Sierra foothills W of Big Pine, near rocks in coarse granite sand, 15 May 1906, *A. A. Heller 8259* (holotype, GH; isotypes, CAS, MO, NY not seen, US).

Boechera johnstonii (Munz) Al-Shehbaz, comb. nov. Basionym: *Arabis johnstonii* Munz, Bull. S. Calif. Acad. Sci. 31: 63. 1932. TYPE: U.S.A. California: Riverside Co., Kenworthy, Thomas Valley, San Jacinto Mts., 4500 ft., 19 May 1922, *P. A. Munz & I. M. Johnston 5485* (holotype, POM; isotypes, CAS, GH).

Boechera koehleri (T. J. Howell) Al-Shehbaz, comb. nov. Basionym: *Arabis koehleri* T. J. Howell, Fl. Northw. Amer. 1: 44. 1897. TYPE: U.S.A. Oregon: Douglas Co., Cost Mts., along Umpqua River at Roseburg, cliffs, 17 Apr. 1887, *T. J. Howell s.n.* (holotype, ORE not seen; isotypes, GH, NY not seen, US, WTU not seen).

Although no chromosome count is known for the species, the presence of falcate fruits and subdendritic trichomes supports the assignment of the species to *Boechera*.

Boechera laevigata (Muhlenberg ex Willdenow) Al-Shehbaz, comb. nov. Basionym: *Turritis laevigata* Muhlenberg ex Willdenow, Sp. Pl. 3(2): 543. 1801. *Arabis laevigata* (Muhlenberg ex Willdenow) Poiret, Encycl. Suppl. 1: 411. 1810. TYPE: U.S.A. Pennsylvania: without locality, *G. H. E. Muhlenberg s.n.* (holotype, PH not seen).

On the basis of having a chromosome number of $2n = 14$ (Rollins, 1993b) and falcate fruits, the species is easily assigned to *Boechera*.

Boechera lasiocarpa (Rollins) Dorn, Brittonia 55: 3. 2003. Basionym: *Arabis lasiocarpa* Rollins, Syst. Bot. 6: 58. 1981. TYPE: U.S.A. Utah: Rich Co., 6 mi. W of Garden City, off U.S. Hwy. 89, Wasatch Range, high ridge, sedimentary rock, 22 June 1979, *R. C. & K. W. Rollins 79307* (holotype, GH; isotypes, MO [2], RM, UC).

Boechera lemmonii (S. Watson) W. A. Weber, Phytologia 51: 370. 1982. Basionym: *Arabis lemmonii* S. Watson, Proc. Amer. Acad. 22: 467. 1887. TYPE: U.S.A. California: Lassen Peak, Sep. 1872, *J. G. Lemmon 23* (lectotype, designated by Rollins (1941: 383), GH).

Watson (1887) cited nine syntypes under the original description of *Arabis lemmonii*. Rollins (1941) listed Lemmon's collection as the type, and this was taken as the lectotype. Rollins (1993b) recognized four varieties, of which two were treated by Mulligan (1996) as distinct species, *A. depauperata* A. Nelson & Kennedy and *A. drepanoloba*

Greene. I have not examined the holotypes of these two and therefore refrain from recognizing them at any rank. The accounts in Rollins (1993b) and Mulligan (1996) of these two species, as well as *A. lemmonii*, *A. lyallii*, and *A. microphylla*, hardly show any agreement. For example, Mulligan listed *A. nubigena* J. F. Macbride & Payson as a synonym of *A. depauperata*, whereas Rollins treated it as a variety of *A. lyallii* and recognized *A. depauperata* as a variety of *A. lemmonii*. Furthermore, Mulligan described the new species *A. codyi* G. A. Mulligan, but this is morphologically indistinguishable from *A. nubigena*.

Boechera lignifera (A. Nelson) W. A. Weber, Phytologia 51: 370. 1982. Basionym: *Arabis lignifera* A. Nelson, Bull. Torr. Bot. Club 26: 123. 1899. TYPE: U.S.A. Wyoming: Sweetwater Co., Green River, 4 June 1898, *A. Nelson 4711* (holotype, RM; isotypes, GH, MO, US).

Boechera lyallii (S. Watson) Dorn, Vasc. Pl. Wyom. ed. 3: 376. 2001. Basionym: *Arabis lyallii* S. Watson, Proc. Amer. Acad. 11: 122. 1875. TYPE: U.S.A. Washington: Fort Coville to the Rocky Mts., 1861, *Lyall s.n.* (lectotype, designated by Rollins (1941: 367), GH).

Arabis murrayi G. A. Mulligan, Rhodora 97: 151. 1996. Syn. nov. TYPE: Canada. Yukon: Kaskawulsh nunatak, junction N & Central arms Kaskawulsh Glacier, W of Kluane Lake, 6000 ft., unstable slopes, 1 July–1 Aug. 1965, *D. F. & D. B. Murray 91b* (holotype, DAO).

Watson (1871) cited four collections (two of his and one each by Lyall and Brewer) under *Arabis drummondii* var. *alpina* S. Watson. However, in the original description of *A. lyallii*, he (Watson, 1875) listed *A. drummondii* var. *alpina* as a synonym but did not cite any collections. It is possible that *A. lyallii* was intended as a new name at the specific rank because of the pre-existence of *A. alpina* L. Both Hopkins (1937) and Rollins (1941) indicated that the type of *A. lyallii* is Lyall's specimen above, and this should be an effective lectotypification of the species. Hopkins also indicated that *Waston 75* (GH) is the type of *A. drummondii* var. *alpina*, and this led Mulligan (1996) to take this collection as the lectotype of both *A. lyallii* and *A. drummondii* var. *alpina*. In my opinion, the typification of *A. lyallii* by both Hopkins (1937) and Rollins (1941) should be accepted.

Mulligan (1996) reduced *Arabis davidsonii* Greene to synonymy of *A. lyallii*, whereas Rollins (1941, 1993a, b) treated these as distinct species. An examination of the types of both taxa shows that they are not sufficiently distinct, and I tend to agree with Mulligan's opinion.

A critical study of the type collections of *Boechera lyallii* and *Arabis murrayi*, along with a very broad spectrum of material from throughout the range of the former, clearly shows that the alleged difference on which *A. murrayi* is based (cauline leaves minutely auriculate or not auriculate vs. leaves strongly auriculate in *B. lyallii*) does not hold at all. The development of auricles in this species, as well as several others (including *B. holboellii*), can be dramatic and can vary within a single population. If this character is taken at face value, one would have to recognize *A. murrayi* within populations of the entire range of *B. lyallii*, not just in Canada and neighboring Washington. The alleged differences in the trichomes of both species (Mulligan, 1996: 153), "mostly 0.125 mm wide" in *A. murrayii* versus "mostly 0.25 mm wide" in *A. lyallii*, cannot be justified as a reliable difference either. Trichomes, just as other characters, can vary in size within the same population. For these reasons, I do not find adequate grounds that support the recognition of *A. murrayi*.

Boechera microphylla (Nuttall) Dorn, Vasc. Pl. Wyom. ed. 3: 376. 2001. Basionym: *Arabis microphylla* Nuttall, in Torrey & A. Gray, Fl. N. Amer. 1: 82. 1838. TYPE: U.S.A. Rocky Mountains, *T. Nuttall s.n.* (holotype, PH; isotype, BM).

Boechera missouriensis (Greene) Al-Shehbaz, comb. nov. Basionym: *Arabis missouriensis* Greene, Repert. Sp. Nov. Regni Veg. 5: 244. 1908. TYPE: U.S.A. Missouri: Montier, 15 May 1894, *B. F. Bush 31* (holotype, NDG 4416; isotype, GH).

Mulligan (1996) reduced this species to synonymy of *Arabis laevigata*, but the differences in leaf shape, margin, and apex, as well as petal length in relation to sepals (see Rollins, 1993b: 117) justify the recognition of two closely related species.

Boechera ophira (Rollins) Al-Shehbaz, comb. nov. Basionym: *Arabis ophira* Rollins, Syst. Bot. 6: 56. 1981. TYPE: U.S.A. Nevada: Nye Co., Toiyabe Range, near Ophir Pass, T13N, R41E, open rocky area, 13 June 1979, *R. C. & K. W. Rollins 79231* (holotype, GH; isotype, GH).

Boechera oxylobula (Greene) W. A. Weber, Phytologia 51: 370. 1982. Basionym: *Arabis oxylobula* Greene, Pittonia 4: 195. 1900. TYPE: U.S.A. Colorado: Garfield Co., Glenwood Springs, 18 June 1899, *G. E. Osterhout* (holotype, NDG 4427; isotype, RM).

Boechera pallidifolia (Rollins) W. A. Weber, Phytologia 79: 65. 1996. Basionym: *Arabis pallidifolia* Rollins, Cruciferae of Continental North America 181. 1993. TYPE: U.S.A. Colorado: Gunnison Co., high hill above Sapinero, steep hillside among rocks & low sagebrush, 18 June 1983, *R. C. Rollins, K. W. Rollins & A. G. Roads 8376* (holotype, GH; isotypes, GH, UC).

Boechera parishii (S. Watson) Al-Shehbaz, comb. nov. Basionym: *Arabis parishii* S. Watson, Proc. Amer. Acad. Arts 22: 468. 1887. TYPE: U.S.A. California: San Bernardino Co., Bear Valley, San Bernardino Mts., 6500 ft., June 1886, *S. B. Parish 1793* (holotype, GH; isotype, UC).

Boechera patens (Sullivant) Al-Shehbaz, comb. nov. Basionym: *Arabis patens* Sullivant, Amer. J. Sci. 42: 49. 1842. TYPE: U.S.A. Ohio: rocky banks of Scioto River, near Columbus, 1840, *W. S. Sullivant s.n.* (holotype, PH; isotype, GH).

Boechera pendulina (Greene) W. A. Weber, Phytologia 51: 370. 1982. Basionym: *Arabis pendulina* Greene, Leafl. Bot. Obs. Crit. 2: 81. 1910. TYPE: U.S.A. Nevada: Clark Co., Charleston Mts., 7000–8000 ft., May–Oct. 1898, *C. A. Purpus 6104* (holotype, US; isotypes, RM, UC [2]).

Boechera perennans (S. Watson) W. A. Weber, Phytologia 51: 370. 1982. Basionym: *Arabis perennans* S. Watson, Proc. Amer. Acad. Arts 22: 467. 1887. TYPE: U.S.A. Arizona: Pima Co., Santa Catalina Mts., rocky canyon, 15 Apr. 1881, *C. G. Pringle s.n.* (holotype, GH; isotype, MO).

Boechera perstellata (E. Braun) Al-Shehbaz, comb. nov. Basionym: *Arabis perstellata* E. Braun, Rhodora 42: 47. 1940. TYPE: U.S.A. Kentucky: Franklin Co., Elkhorn Creek, wooded hillsides, 6 May 1936, *E. L. Braun 1226* (holotype, GH).

Boechera pinzlae (Rollins) Al-Shehbaz, comb. nov. Basionym: *Arabis pinzlae* Rollins, Contr. Gray Herb. 212: 110. 1982. TYPE: U.S.A. Nevada: Esmeralda Co., White Mts., bowl on NE side of Boundary Peak, near center of bowl, ca. 11,200 ft., *A. Pinzl 4442* (holotype, GH; isotype, GH).

Boechera platysperma (A. Gray) Al-Shehbaz, comb. nov. Basionym: *Arabis platysperma* A. Gray, Proc. Amer. Acad. Arts 6: 519. 1865. TYPE: U.S.A. California: Alpine Co., Ebbetts Pass, 1863, *W. H. Brewer 1989* (lectotype, designated by Rollins (1941: 473), GH; isotypes, UC, US).

Gray (1865) cited two syntypes under the original description of *Arabis platysperma*. Rollins (1941) listed Brewer's collection as the type, and this was accepted as the lectotype of the species.

Boechera puberula (Nuttall) Dorn, Brittonia 55: 3. 2003. Basionym: *Arabis puberula* Nuttall, in Torrey & A. Gray, Fl. N. Amer. 1: 82. 1838. TYPE: U.S.A. Oregon?: Blue Mts., *T. Nuttall s.n.* (holotype, PH).

Boechera pulchra (M. E. Jones ex S. Watson) W. A. Weber, Phytologia 51: 370. 1982. Basionym: *Arabis pulchra* M. E. Jones ex S. Watson, Proc. Amer. Acad. 22: 468. 1887. TYPE: U.S.A. Nevada: Ormsby Co., Empire City, 19 June 1882, *M. E. Jones 3765* (lectotype, designated by Rollins (1941: 459), GH; isotypes, DS, MO, NY not seen, POM, UC, US [2]).

Watson (1887) cited seven syntypes under the original description of *Arabis pulchra*. Rollins (1941) listed *Jones 3765* collection as the type, and this was taken here as the lectotype.

Boechera pusilla (Rollins) Dorn, Vasc. Pl. Wyom. ed. 3: 376. 2001. Basionym: *Arabis pusilla* Rollins, Contr. Gray Herb. 212: 107. 1982. TYPE: U.S.A. Wyoming: Fremont Co., off Wyoming State Hwy. 28, 39 mi. SW of Lander, cracks & crevices of huge metamorphosed rocks, 20 June 1981, *R. C. & K. W. Rollins 81366* (holotype, GH; isotypes, GH, MO, RM, UC).

Boechera pygmaea (Rollins) Al-Shehbaz, comb. nov. Basionym: *Arabis pygmaea* Rollins, Rhodora 43: 476. 1941. TYPE: U.S.A. California: Tulare Co., basin of the Upper Kern River, Volcano Meadows (formerly Whitney Meadows), 21 July 1904, *H. M. Hall & H. D. Babcock 5465* (holotype, GH; isotypes not seen, MO, NY, OSC, US).

Boechera rectissima (Greene) Al-Shehbaz, comb. nov. Basionym: *Arabis rectissima* Greene, Pittonia 4: 191. 1900. TYPE: U.S.A. California: Fresno Co., 1890, *Peckinpah s.n.* (holotype, NDG 4469; isotype, NY not seen).

Boechera repanda (S. Watson) Al-Shehbaz, comb. nov. Basionym: *Arabis repanda* S. Watson, Proc. Amer. Acad. Arts 11: 122. 1875. TYPE: U.S.A. California: Mariposa Co., Yosemite Valley, 1866, *H. N. Bolander 4881* (holotype, GH; isotype, UC).

Boechera rigidissima (Rollins) Al-Shehbaz, comb. nov. Basionym: *Arabis rigidissima* Rollins, Rhodora 43: 380. 1941. TYPE: U.S.A. California: Trinity Co., Mary Blaine Mt., gravelly or rocky soil, 6400 ft., 3 Aug. 1935, *J. P. Tracy 14469* (holotype, GH; isotype, DS).

Boechera rollei (Rollins) Al-Shehbaz, comb. nov. Basionym: *Arabis rollei* Rollins, Harvard Pap. Bot. 4: 43. 1993. TYPE: U.S.A. California: Siskiyou Co., divide betw. Applegate & Klamath Rivers, Red Butte-Kangaroo Mt.–Lilypad Lake–Towhead Lake area, T47N, R12W, Sec. 13, 5400–5900 ft., 4 Aug. 1983, *W. E. Rolle 831* (holotype, GH; isotypes, GH, JEPS).

Boechera schistacea (Rollins) Dorn, Brittonia 55: 3. 2003. Basionym: *Arabis schistacea* Rollins, Contr. Dudley Herb. 3: 370. 1946. TYPE: U.S.A. Nevada: Nye Co., 15 mi. W of Round Mt., Toiyabe Mts., open slope, 9000 ft., 11 July 1938, *R. C. Rollins & T. S. Chambers 2512* (holotype, DS; isotype, GH).

Boechera selbyi (Rydberg) W. A. Weber, Phytologia 51: 371. 1982. Basionym: *Arabis selbyi* Rydberg, Bull. Torr. Bot. Club 31: 557. 1904. TYPE: U.S.A. Colorado: Ouray Co., W of Ouray, 9 Sep. 1901, *L. M. Underwood & A. D. Selby 207* (holotype, NY not seen).

Boechera shockleyi (Munz) Dorn, Brittonia 55: 3. 2003. Basionym: *Arabis shockleyi* Munz, Bull. S. Calif. Acad. Sci. 31. 62. 1932. TYPE: U.S.A. Nevada: Esmeralda Co., Mellin Mt., near Candelaria, May 1884, *W. H. Shockley 366* (holotype, GH; isotypes, JEPS, NDG, US).

Boechera shortii (Fernald) Al-Shehbaz, comb. nov. Basionym: *Arabis perstellata* var. *shortii* Fernald, Rhodora 48: 208. 1946. *Sisymbrium dentatum* Torrey, in Short, 3rd Suppl. Cat. Pl. Kentucky 338. 1833, non *S. dentatum* Allioni, Fl. Pedem. 1: 275. 1785. TYPE: U.S.A. Kentucky: sandy banks of the Ohio River, *C. W. Short s.n.* (lectotype, designated by Mulligan (1996: 143), DWC; isotype, GH).

For full synonymy of the species, see Rollins (1993b).

Boechera sparsiflora (Nuttall) Dorn, Vasc. Pl. Wyom. ed. 3: 376. 2001. Basionym: *Arabis sparsiflora* Nuttall, in Torrey & A. Gray, Fl. N. Amer. 1: 81. 1838. TYPE: U.S.A. Rocky Mts., toward sources of Oregon, *T. Nuttall s.n.* (holotype, BM; photo, GH; isotype, PH).

Rollins (1941) indicated that Nuttall's sheet at PH is the isotype, whereas Mulligan (1996) considered that sheet a mixture of more than one species and designated the specimen to the far right as the lectotype. I have examined the type at BM and agree with Rollins's conclusion.

Boechera stricta (Graham) Al-Shehbaz, comb. nov. Basionym: *Turritis stricta* Graham, Edinburgh New Philos. J. 7: 350. 1829. *Arabis drummondii* A. Gray, Proc. Amer. Acad. Arts 6: 187. 1864. TYPE: U.S.A. Rocky Mts., grown from seeds, *Drummond s.n.* (holotype, E).

The nomenclature of this species is confusing, and the species epithet has not been used since the mid 19th century. The species is far better known as *Arabis drummondii* A. Gray, a name proposed by Gray (1864) to avoid the creation of a later homonym that would have resulted from the transfer of *Turritis stricta* to *Arabis* because of the existence of *A. stricta* Hudson published in 1777 (Fl. Angl. 1: 292. 1777). The transfer by Löve and Löve (1976) of *A. drummondii* to *Boechera* is illegitimate because these authors did not use *T. stricta*, the legitimate, validly published, and earliest basionym for the species.

Boechera subpinnatifida (S. Watson) Al-Shehbaz, comb. nov. Basionym: *Arabis subpinnatifida* S. Watson, Proc. Amer. Acad. Arts 20: 353. 1885. TYPE: U.S.A. Oregon: Josephine Co., Waldo, 3 June 1884, *T. Howell s.n.* (lectotype, designated by Rollins (1941: 454), GH; isotypes, NY not seen, US).

Watson (1885) cited two syntypes under the original description of *Arabis subpinnatifida.* Rollins (1941) listed Howell's collection as the type, and this was taken as the lectotype of the species.

Boechera suffrutescens (S. Watson) Dorn, Brittonia 55: 3. 2003. Basionym: *Arabis suffrutescens* S. Watson, Proc. Amer. Acad. Arts 17: 362. 1882. TYPE: U.S.A. Oregon: Baker Co., bluffs of Snake River & vicinity, Apr. 1881, *W. C. Cusick 919* (holotype, GH).

Boechera tiehmii (Rollins) Al-Shehbaz, comb. nov. Basionym: *Arabis tiehmii* Rollins, J. Arnold Arbor. 64: 496. 1983. TYPE: U.S.A. Nevada: Washoe Co., Sierra Nevada, Carson Range, ridge N of Mt. Rose, 3/4 air mi. N-NW of peak, T17N, R18E, Sec. 11, 10,200 ft., near rock outcrops on decomposed granite, 19 Aug. 1982, *A. Tiehm 7561* (holotype, GH; isotypes, CAS, GH, RSA).

Boechera williamsii (Rollins) Dorn, Vasc. Pl. Wyom. ed. 3: 376. 2001. Basionym: *Arabis williamsii* Rollins, Syst. Bot. 6: 62. 1981. TYPE: U.S.A. Wyoming: Fremont Co., off Wyoming Hwy. 28, E of Continental Divide on SE approach to Wind River Mts., coarse granitic soil, 7800 m, 26 June 1979, *R. C. & M. L. Rollins 79332* (holotype, GH; isotypes, GH, MO, RM, UC).

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A Synopsis of *Tropidocarpum* (Brassicaceae)

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ABSTRACT. *Twisselmannia californica* is transferred to *Tropidocarpum* (Brassicaceae). A key to the four species of *Tropidocarpum* is presented. Disjunction between the North and South American species of the genus is discussed.

Key words: *Agallis*, Brassicaceae, fruit diversity, *Tropidocarpum*, *Twisselmannia*.

As presently delimited, *Tropidocarpum* Hooker (Brassicaceae) consists of four species, of which *Twisselmannia californica* Al-Shehbaz and *Agallis lanata* (Barnéoud) Gilg & Muschler ex O. E. Schulz were previously placed in monotypic genera. The narrowly endemic *T. californica* is restricted to a limited number of scrub habitats in the Central Valley of California (Al-Shehbaz, 1999). Although *Twisselmannia* Al-Shehbaz was reduced to synonymy of *Tropidocarpum* by Appel and Al-Shehbaz (2002), formal transfer of its species to *Tropidocarpum* was not proposed. *Agallis lanata* is very rare and occurs disjunctly in central Chile in habitats similar ecologically to those where species of *Tropidocarpum* grow. It was transferred to *Tropidocarpum* by Al-Shehbaz and Price (2001). Of the other two species originally assigned to *Tropidocarpum*, *T. gracile* Hooker is a relatively widespread and abundant species occurring in open habitats and lower montane slopes from Baja California north to central California (see below), whereas *T. capparideum* Greene is an extremely rare species previously known only from the vicinity of Mt. Diablo in the San Francisco Bay area of California (Rollins, 1993a, 1993b). *Tropidocarpum capparideum* was not collected for nearly 45 years and was last seen in 1957 and presumed extinct (Rollins, 1993b). However, the species has been collected in 2000 by Meredith Osborne (CDA) and in 2001 by Fred Hrusa (CDA) and Dieter Wilken (SBBG). These collections, all cited below, were made from Fort Hunter Liggett in Monterey County, and I have confirmed their identity.

All four species are annuals with a remarkably similar morphology, especially in their indumentum (with coarse simple trichomes mixed with smaller forked ones), petiolate and pinnatisect to pinnatifid cauline leaves, racemes bracteate throughout, yellow flowers occasionally tinged with purple, staminal filaments with dilated bases, angustiseptate fruits (flattened at a right angle to the septum), mucilaginous seeds, and incumbent cotyledons. However, they have drastically different fruits (Fig. 1). *Twisselmannia* has a very distinctive obdeltoid silicle (4–5 × 3–4 mm) with leathery-thickened and tuberculate-rugose valves, whereas *Tropidocarpum gracile* has narrowly linear siliques up to 7 cm × 2 mm. Both *T. capparideum* and *T. lanatum* (Barnéoud) Al-Shehbaz & R. A. Price have oblong fruits, but the former has four rather than two valves, a condition rarely seen elsewhere within the Brassicaceae (Al-Shehbaz, 1984).

Molecular studies of *Twisselmannia californica*, *Tropidocarpum gracile*, and *T. lanatum* (Price, unpublished) demonstrate that the three species are almost identical in sequence, differing by only 1 or 2 base pair substitutions, for the chloroplast gene *ndh*F and the nuclear ribosomal DNA ITS region. The three species form a monophyletic clade, with 100% bootstrap support, and this clade is weakly separated (54% bootstrap support) from a monophyletic *Descurainia* Webb & Berthelot including *Hugueninia* Reichenbach (Price, unpublished). Because of the extremely small amount of sequence divergence observed among the three species for the rapidly changing *ndh*F and ITS regions, it appears that both the drastic change in fruit shape between *Twisselmannia* and its *Tropidocarpum* congeners and the North American–South American disjunction involving *T. lanatum* are relatively recent events in the history of the Brassicaceae.

Fruit and seed morphology have traditionally been heavily emphasized in generic and tribal classification of the Brassicaceae (Hedge, 1976; Al-Shehbaz, 1984), but recent molecular phylogenetic studies suggest that fruit and seed morphology have been subject to frequent homoplasy (Koch et al., 1999, 2001) and that many of the commonly recognized tribes in the family are highly artificial.

Remarkable differences in fruit morphology are found in several other genera of the Brassicaceae. For example, *Rorippa* Scopoli (ca. 75 spp., distributed worldwide) has fruits ranging from narrowly

linear to oblong or globose and with two or rarely three to six valves (Appel & Al-Shehbaz, 2002). Another striking example of fruit diversity is found in *Vella* L., a genus of seven species of shrubs endemic to Algeria, Morocco, and Spain (Appel & Al-Shehbaz, 2002). All species of *Vella* have segmented, 1- to 8-seeded fruits, connate median staminal filaments, and a base chromosome number of $x = 17$ (Warwick & Al-Shehbaz, 1998). One species, *V. bourgaeana* (Cosson) Warwick & Al-Shehbaz, previously treated as the monotypic genus *Euzomodendron* Cosson (López González, 1993), has linear-lanceolate fruits and seeds broadly winged all around, whereas the remaining species have globose to ellipsoid fruits and seeds with vestigial wings. Molecular data (Warwick & Black, 1994; Crespo et al., 2000) clearly show that *Euzomodendron* is nested within *Vella*, and thus they form a monophyletic genus. Several other genera of Brassicaceae show very wide ranges of fruit morphology. These include *Draba* L. (Schulz, 1936), *Heliophila* L. (Marais, 1970), *Graellsia* Boissier (Poulter, 1956), *Isatis* L. (Davis, 1964), *Leavenworthia* Torrey (Rollins, 1963), *Ornithocarpa* Rose (Rollins, 1969), and *Sphaerocardamum* Schauer (Bailey, 2001).

The almost identical sequence similarity between *Twisselmannia* and species of *Tropidocarpum* contrasts with the apparent rapidity with which major changes in fruit morphology can sometimes occur among closely related taxa. A classic example of a similar situation was elucidated earlier by Sytsma and Gottlieb (1986) in the evolution of the strikingly divergent *Heterogaura* from within the genus *Clarkia* Pursh (Onagraceae). It would be particularly interesting to conduct comparative genetic and developmental studies of the fruits of *Tropidocarpum*, including *Twisselmannia*.

Another interesting aspect of the genus *Tropidocarpum* is the large disjunction between the Mediterranean climate zones of California and Chile (Fig. 1), which was unrecognized until Al-Shehbaz and Price (2001) transferred *Agallis lanata* to *Tropidocarpum*. The pattern of disjunction among species of many genera between these environmentally similar areas of North and South America was elegantly covered by Raven and Axelrod (1978).

KEY TO THE SPECIES OF *TROPIDOCARPUM*

1a. Fruits obdeltoid, spreading or antrorsely hirsute, 4- to 8-seeded; valves thick leathery, tuberculate-rugose distally . . . . . *T. californicum*
1b. Fruits linear, oblong, or elliptic, retrorsely hirsute (except when glabrescent), 16- to 70-seeded; valves thin-leathery, smooth.
  2a. Fruits narrowly linear, (2.5–)3–6(–7) cm × 1.5–2 mm . . . . . *T. gracile*
  2b. Fruits oblong to elliptic, 1–2(–2.5) cm × 3–5 mm.
    3a. Fruit valves 4; anthers oblong, 0.4–0.5 mm; fruit 25- to 40-seeded; California . . . . . *T. capparideum*
    3b. Fruit valves 2; anthers ovate, 0.15–0.25 mm; fruit 16- to 26-seeded; Chile . . . . . *T. lanatum*

1. Tropidocarpum californicum (Al-Shehbaz) Al-Shehbaz, comb. nov. Basionym: *Twisselmannia californica* Al-Shehbaz, Novon 9: 132. 1999. TYPE: U.S.A. California: Kings Co., S of Kettleman City, E side of Interstate Hwy. 5, 3 mi. N of Kern Co. line, grazed valley saltbush scrub, 30 Mar. 1994, *Ed LaRue s.n.* (holotype, UCR).

Distribution. U.S.A. California: Kings County.

Specimens examined. U.S.A. **California:** Kern Co., Kern National Wildlife Refuge, *Twisselmann 10447* (CDA); Kings Co., ca. 13 mi. S of Kettleman City, along pipeline access road lying 0.3 mi. E of Interstate 5, 3.1 mi. N of Kern Co. line, *Taylor 17098 & Ertter* (MO, UC).

To my knowledge, the collections above represent all that is known for the species.

2. Tropidocarpum capparideum Greene, Pittonia 1: 217. 1888. TYPE: U.S.A. California: [Contra Costa Co.], alkaline valley lands skirting the San Joaquin River, [Byron Springs], 25 Mar. 1888, *E. L. Greene s.n.* (holotype, NDG 02806).

Distribution. U.S.A. California: Contra Costa and Monterrey Counties.

Specimens examined. U.S.A. **California:** Contra Costa Co., Byron Hot Springs, *Hoover 806* (MO); Monterry Co., Fort Hunter Liggett, adjacent to Gabilan Road, ca. 0.8 mi. SSE of intersection with San Migelito Loop, *Hrusa 15805, with Wilken & Hazebrook* (CDA, MO), *Osborne 16, with Guzman & Witmore* (CDA, MO), *Hrusa 15804, with Wilken & Hazebrook* (CDA, MO); W of Gabilan Creek, ca. 0.4 km S of junction of Gabilan and San Migelito Loop roads, *Wilken 15876, with Morosco* (MO, SBBG).

The single specimen in Greene's herbarium collected in March 1888 was from Byron Springs, a locality not given in the original publication of the species. This specimen is taken herein as the holotype.

3. Tropidocarpum gracile Hooker, Icon. Pl. t. 43. 1836. TYPE: U.S.A. California: Monterey Co., Monterey, *David Douglas s.n.* (holotype, K).

Distribution. Mexico. Northern Baja California. U.S.A. California: Inner Coastal Range, Cascade

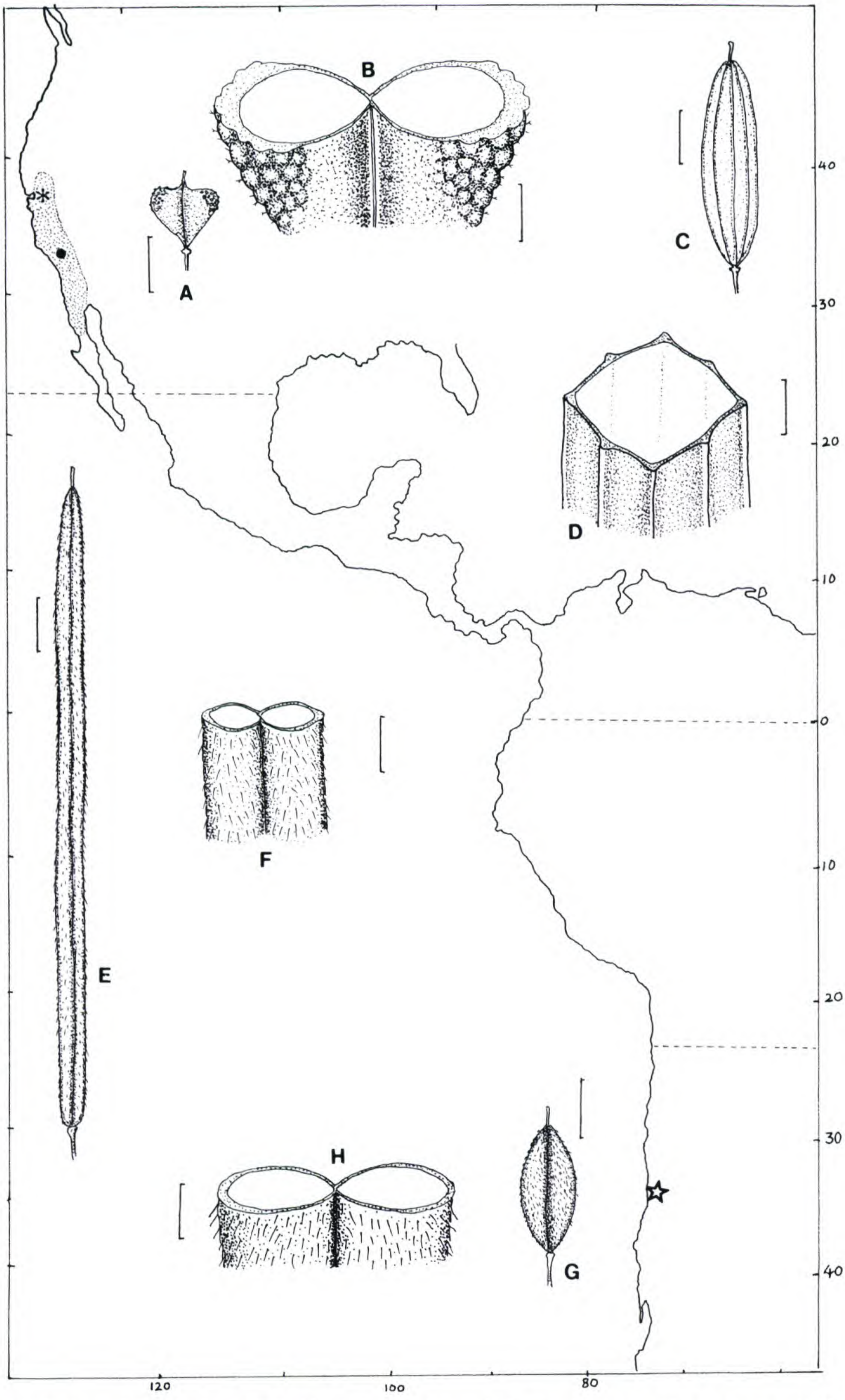

Figure 1. Fruits and distributions of *Tropidocarpum* species. —A, B. *T. californicum* (dot on map). —C, D. *T. capparideum* (asterisk). —E, F. *T. gracile* (stippled area). —G, H. *T. lanatum* (star). Cross sections in B, D, F, and H are made in widest portion of fruit. Scale: A, C, E, G = 5 mm; B, D, F, H = 1 mm. Dotted lines represent Tropic of Cancer, Equator, and Tropic of Capricorn. Drawn by Al-Shehbaz: A, B from *LaRue s.n.* (holotype, UCR); C, D from *Hoover 806* (MO); E, F from *Blankinship s.n.* (MO); G, H from *Claude Joseph 2791* (US).

Range foothills, Tehachapi Mountain, Great Central Valley, San Francisco Bay Area, Inner South Coast Range, Southwest California, and western Mojave Desert (Rollins, 1993b).

Specimen examined. U.S.A. **California:** Lake Co., Mt. Konocti, 29 Apr. 1929, *Blankinship s.n.* (MO).

4. Tropidocarpum lanatum (Barnéoud) Al-Shehbaz & R. A. Price, Novon 11: 293. 2001. Basionym: *Lepidium lanatum* Barnéoud, in Gay, Fl. Chile 1: 167. 1846. TYPE: Chile. Santiago, *C. Gay s.n.* (holotype, P; photos, F, US).

Distribution. Chile, Región IV and Región Metropolitana.

Specimens examined. CHILE. **Región IV:** Fray Jorge, Las Papas, *Jiles 720* (S); Ovalle, Bosque Fray Jorge, *Sparre 3029* (S). **Región Metropolitana:** Santiago, *Claude-Joseph 2232, 2267* (US); Lo Prado, *Claude-Joseph 2791* (US).

The above collections are the only ones known for the species, and the latest, *Jiles 720,* was made on 22 August 1948. No more recent collections are known for the species.

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Transberingia, a New Generic Name Replacing the Illegitimate *Beringia* (Brassicaceae)

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ABSTRACT. *Transberingia* Al-Shehbaz & O'Kane (Brassicaceae) replaces *Beringia* R. A. Price, Al-Shehbaz & O'Kane, a later homonym to a genus of the red algae. The new combinations *T. bursifolia* and *T. bursifolia* subsp. *virgata* are made for the sole species of this genus.

Key words: *Arabidopsis*, *Beringia*, Brassicaceae, North America, Russia, *Transberingia*.

Beringia R. A. Price, Al-Shehbaz & O'Kane (Brassicaceae) was named by Price et al. (2001) as a monotypic genus to accommodate one species of mustard excluded by Al-Shehbaz et al. (1999) from *Arabidopsis* (DC.) Heynhold. The species, hereafter *Transberingia bursifolia*, is distributed in western North America across the Bering Strait, hence the generic name *Transberingia*, into the Russian Far East (Berkutenko, 1988; Price et al., 2001; Rollins, 1993). As indicated by Aiken et al. (2003), *Beringia* is a later homonym of a genus of Rhodophyta (red algae) named by Perestenko (1975). Therefore, the following nomenclatural adjustment is proposed to replace the illegitimate name *Beringia* of the Brassicaceae, as well as a new combination at the species and subspecies ranks recognized by Price et al. (2001).

Transberingia Al-Shehbaz & O'Kane, nom. nov. Replaced name: *Beringia* R. A. Price, Al-Shehbaz & O'Kane, Novon 11: 333. 2001, non *Beringia* Perestenko, Bot. Zhurn. (Moscow & Leningrad) 60: 1683. 1975. TYPE: *Transberingia bursifolia* (DC.) Al-Shehbaz & O'Kane.

Transberingia bursifolia (DC.) Al-Shehbaz & O'Kane, comb. nov. Basionym: *Nasturtium bursifolium* DC., Syst. Nat. 2: 194. 1821. TYPE: [Russia]. Kamtchatka, *Friedrich E. L. von Fischer s.n.* (holotype, G-DC).

For a detailed synonymy of the species and following subspecies, see Price et al. (2001).

Transberingia bursifolia subsp. **virgata** (Nuttall) Al-Shehbaz & O'Kane, comb. nov. Basionym: *Sisymbrium virgatum* Nuttall, in Torrey & A. Gray, Fl. N. Amer. 1: 93. 1838. TYPE: U.S.A. Rocky Mts. [probably Wyoming], "sources of Sweet Water of the Platte," *Thomas Nuttall s.n.* (holotype, BM; isotypes, GH, NY, PH).

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An Overlooked New Species of *Habenaria* (Orchidaceae) from Central Brazil

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ABSTRACT. *Habenaria pabstii*, a new species (Orchideae, Orchidaceae) from the core region of the cerrado vegetation of central Brazil, is described and illustrated. The species has been collected since 1961, but was repeatedly misidentified as other taxa. The species is similar to those in section *Macroceratitae* Kraenzlin, but distinct by the shorter, forward-arched, free spur and the shorter, non-involute stigmas.

RESUMO. *Habenaria pabstii*, uma nova espécie (Orchideae, Orchidaceae) da região nuclear do cerrado do Brasil central é descrita e ilustrada. A espécie tem sido coletada desde 1961, mas foi repetidamente identificada erradamente. A espécie é similar àquelas da seção *Macroceratitae*, mas distinta pelo calcar mais curto, livre, projetado para frente e pelos estigmas mais curtos e não involutos.

Key words: Brazil, cerrado, *Habenaria*, Orchidaceae.

Habenaria Willdenow is the second-largest orchid genus in Brazil, with about 165 species according to the last major survey of Brazilian orchids (Pabst & Dungs, 1975). The genus is composed exclusively of terrestrial species and is typical of open grasslands. Most of the species have small, green, inconspicuous flowers that are of little interest to cultivators and thus rarely seen in cultivation. As a consequence, work on the genus has relied almost completely on botanical collections and on the study of dried material. The three major treatments of the genus for the country so far are those of Cogniaux (1893) in *Flora Brasiliensis*, Hoehne (1940) in *Flora Brasilica*, and Pabst and Dungs (1975, 1977) in *Orchidaceae Brasilienses*. The large number of species, the poor characterization or little information on many taxa, and the existence of several species complexes has given rise to a situation where identification of the species is often troublesome, with different names being applied to the same species and some species being overlooked.

The main center of diversity of *Habenaria* in Brazil is the cerrado. The cerrado is a species-rich savanna vegetation covering 2 million km² of central Brazil (Ratter et al., 1997). Among the *Habenaria* species-rich areas in central Brazil is the core region of the cerrado vegetation, including the Distrito Federal where 77 taxa are known (Batista & Bianchetti, 2003) and neighboring areas in the state of Goiás. In the course of a survey of the orchid flora of this cerrado region, several taxa of *Habenaria* have been collected that we have been unable to assign to any known New World species in the genus, one of which, with large and showy flowers, is hereby described as new.

Habenaria pabstii J. A. N. Batista & Bianchetti, sp. nov. TYPE: Brazil. Distrito Federal: Brasília, Fazenda Água Limpa (UnB), 15°57′S, 47°55′W, 1070 m, Córrego da Onça, 2 Feb. 1994, *L. B. Bianchetti, J. A. N. Batista & B. M. T. Walter 1489* (holotype, CEN; isotypes, HB, K, MO, SP). Figures 1 and 2.

Habenaria pabstii florum generali aspectu speciebus sect. *Macroceratitae* similis sed calcari breviore, libero, frontaliter arcuato et stigmatibus brevioribus, non involutis differt. Etiam *H. urbaniana* similis sed floribus frequenter longioribus et structura columnae prominenti lobo mediano rostelli praedito appendicem similitudine cavernae formans, haec ultra antheras producta differt.

Terrestrial herb. *Tuber* basal, oblong to subspheric, 1.2–2.8 × 0.8–1.7 cm; *roots* ca. 1 mm wide, sparsely hairy, whitened; *stem* erect, leafy, 20–60 × 0.3–0.4 cm including the inflorescence. *Leaves* 7 to 11, the 3 or 4 lowermost sheath-like, the largest around the center of stem, (3)4 to 5(6), spread,

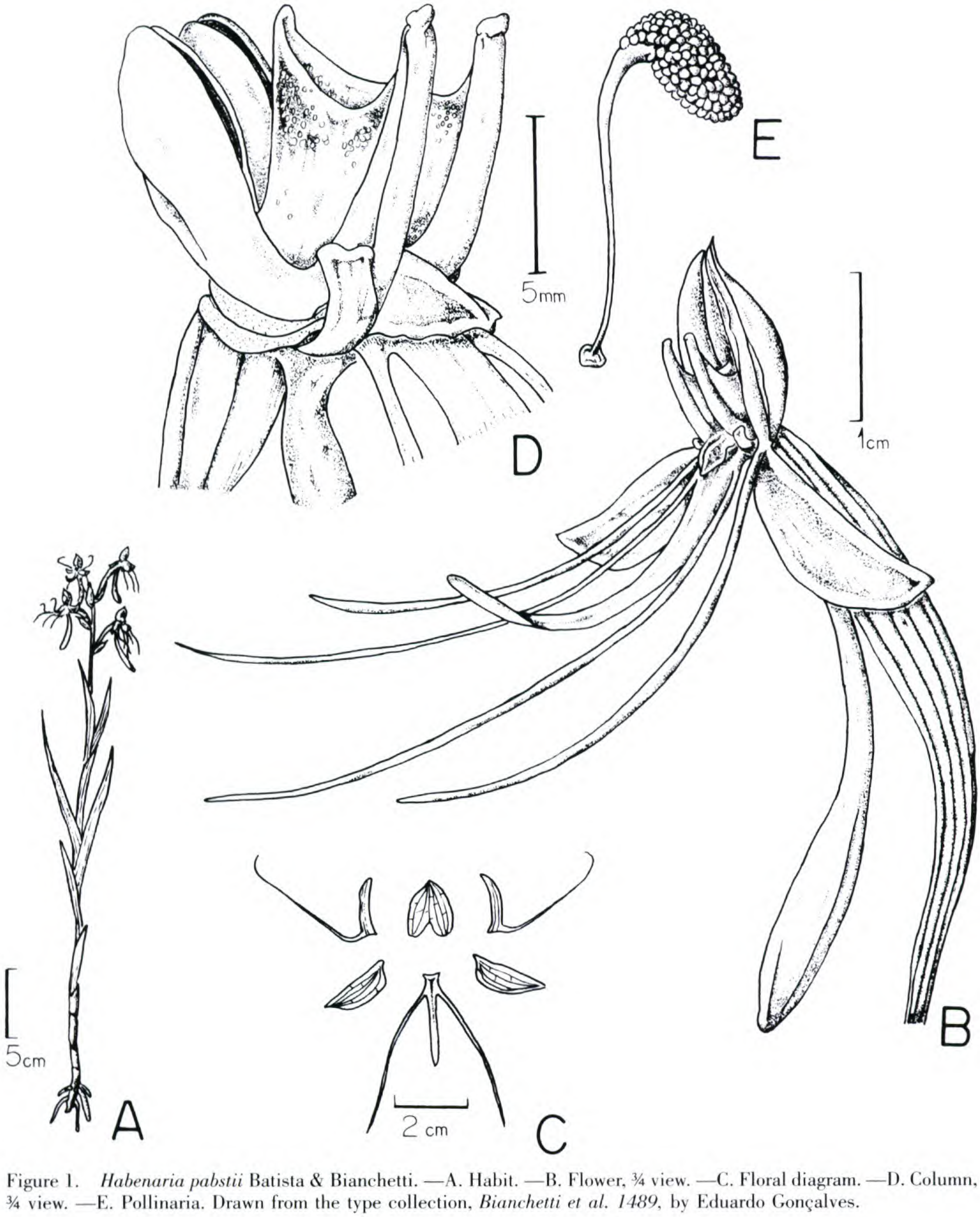

Figure 1. *Habenaria pabstii* Batista & Bianchetti. —A. Habit. —B. Flower, ¾ view. —C. Floral diagram. —D. Column, ¾ view. —E. Pollinaria. Drawn from the type collection, *Bianchetti et al. 1489*, by Eduardo Gonçalves.

linear-lanceolate, 11–21 × 1–1.4 cm, acute, the 1(2) upper leaves decreasing in size and similar to the lower bracts. *Inflorescence* 5–10 cm long, few-flowered; bracts ovate-lanceolate, 1.8–3.1 × 0.8–1 cm, caudate, the lowermost almost the same size as the pedicellate ovary, decreasing in size toward the apex of the inflorescence, green. *Flowers* (1)2 to 5(7), spreading, superimposed, large for the genus, green-white; pedicellate ovary, 2.5–3.5 cm long, slightly arched, green; sepals mucronate, light green with the margins whitened, the veins slightly marked in darker green; dorsal sepal concave, when flattened somewhat elliptic, 12–16 × 8–13 mm; lateral sepals obliquely oblong, 16–20 × 4.5–6.5 mm, acute, deflexed in fully open flowers; petals bipartite, base white or creamy white, green toward the apex; posterior segment linear-falcate, 13–15 × 2–3 mm, acute, base free, toward the apex

Figure 2. *Habenaria pabstii* Batista & Bianchetti. —A. Flower, ¾ view. —B. Column, side view, with the pollinaria removed; An, anther; Ac, anther canal; Au, auricle; Cn, connective; Ro, rostellum; Ra, rostellum arm; St, stigmas; Sp, spur; Ov, ovary. —C. Rostellum, side view. Scale bars = 1 cm (A) and 2 mm (B, C). Photographed from living specimens from the same collection as *Batista 185*.

connivent with the dorsal sepal; anterior segment linear-filiform, 25–43 mm long, 2–2.5(2.8) times longer than the posterior segment, projected forward and somewhat parallel to the lateral lip segments; lip tripartite, projected forward, base white or creamy white and light green toward the apex of the segments; undivided base 2–3 × 2–3 mm; lateral segments linear-filiform, 32–51 mm long, 1.7–2.3 times longer than the medium segment; medium segment shorter and wider, linear-ligulate, 17–24 × 1.5(2) mm, the apex bent upward; spur pendent, clavate, free from the bracts, slightly to strongly arched forward, narrower at the base, progressively thickened toward the apex, 3.3–3.8 cm long, base 1.5 mm wide, apex 2.5–3 mm wide, green; column 6–10 mm high; anthers ca. 4–6 mm tall, white-yellow; anther canals 7–9 mm long, slender, erect, somewhat perpendicular to the anthers; connective emarginate, green; rostellum mid lobe prominent, elongate, forming a tunnel-like structure projected beyond the anthers, ca. 10–11 mm long including the lateral arms, 6–7 mm tall at the apex, fleshy, cuspidate, acute, light green, the base white, slightly bent, forming a discrete groove that extends through the lateral arms and which supports the anther canals; rostellum arms white, 3–4 mm long; auricles erect, ca. 2.5–3 mm tall, fleshy, flattened, verrucose toward the apex, white; stigmas 2, closely parallel, 6–8 mm long including the base, the receptive, exposed surface 3–4 mm long and 2–2.5 mm wide, projected forward, non-involute, upper surface flatly convex, light green; pollinaria 2, yellow, viscidium ca. 1 × 1 mm, spaced 3–5 mm apart; caudicles elongate, 8–10 mm long, about 2–3 mm from the apex, ca. 90° bent; pollinia 4, 3–4 × 1–1.3 mm, laterally flattened, perpendicular to the caudicles main axis. *Fruit* not examined.

Etymology. The new species is named in honor of Guido F. J. Pabst (1914–1980), the late well-known Brazilian orchidologist, author of *Orchidaceae Brasilienses,* who greatly contributed to the knowledge of the orchid flora of central Brazil and who described some new species of *Habenaria.*

Distribution. *Habenaria pabstii* is an occasional species, so far only known from the Distrito Federal and the state of Goiás. It should also be expected in western Minas Gerais, which is floristically related to this core cerrado region, which shares many orchid species in common with the Distrito Federal and Goiás, and probably also in southern Tocantins state, which is close to the known range of the new species.

Habitat, ecology, and phenology. *Habenaria pabstii* is more commonly found in seasonally wet grassy fields, in either hydromorphic or sandy soils. Occasionally, it can also be found growing under drier conditions or, rarely, in permanently wet ground with water at the surface. Like most *Habenaria* species in central Brazil, flowering occurs during the rainy season, from December to late March, extending from the peak to almost the end of the rainy season. Plants frequently appear in great numbers, with apparently only the older and more developed individuals flowering among many still growing younger plants. The flowers usually do not last more than a few days in the field (pers. obs.). Also, like many other *Habenaria* and terrestrial orchids from open grasslands, the flowering of this species is greatly enhanced by bushfires (Jones, 1993; Oliveira et al., 1996). The greatest concentration of flowering plants is usually found in burnt areas, though occasionally some plants can also be found in flower in unburnt places (pers. obs.). The pollination mechanism and pollinators of the species are unknown.

Habenaria pabstii was apparently first collected by Ezechias P. Heringer in 1961 in the Distrito Federal. Analysis of dried specimens collected at that time and examined by Guido F. J. Pabst has revealed that Pabst misidentified the species as *H. fastor* Warming, *H. candolleana* Cogniaux, *H. urbaniana* Cogniaux, and *H. vaupellii* Reichenbach fil. & Warming. These mistakes probably avoided the identification of *H. pabstii* as a new species in the past.

Among Brazilian *Habenaria, H. pabstii* is mostly similar in general flower morphology and size to a species group within section *Macroceratitae,* represented by *H. bractescens* Lindley, *H. fastor* Warming, *H. gourlieana* Gillies ex Lindley, *H. johanennsis* Barbosa Rodrigues, *H. longicauda* Hooker, and *H. macronectar* (Vellozo) Hoehne, hence prior Pabst identifications as *H. fastor* and *H. vaupellii* (a synonym of *H. johannensis*). However, distinct from all these species, *H. pabstii* has a shorter, forward-arched free spur (Figs. 1B, 2A) and shorter, non-involute stigmas, which are closely parallel forming a single receptive surface turned up and frontward (Figs. 1D, 2B). All these other species have pendent spurs, which are completely or partially enclosed by the bracts and which are longer than the ovary and pedicel, ranging from 4 to more than 15 cm, and reaching up to 25 cm in *H. longicauda* (Snuverink & Westra, 1983). Also, their stigmas are always longer (the free part 6–9 mm long in other species with similar flower size), separated and in contact only at the apex, the margins are involute, that is, rolled inward spirally on each side (Stearn, 1983), and the receptive surface at the apex is

mostly turned to the sides. Thus, though *H. pabstii* undoubtedly shares some degree of similarity with these species, it differs in some important details of the column structure, and its exact infrageneric classification is unclear. As current infrageneric classification of *Habenaria* needs a radical reassessment (Pridgeon et al., 2001), further studies, including a molecular analysis, will be necessary to clarify the relationship between *H. pabstii*, the species in section *Macroceratitae*, and other species in the genus.

Among other species in section *Macroceratitae*, *Habenaria pabstii* is also similar in general flower morphology to *H. quinqueseta* (Michaux) A. Eaton. However, this species has the leaves more patent, ovate to lanceolate and broader (2–6 cm wide); petals and lip white; a longer, pendent spur (5–10 cm long, reaching up to 18 cm in *H. quinqueseta* var. *macroceratitis* (Willdenow) Luer); and the rostellum mid lobe smaller, completely placed between the anther sacs (Luer, 1972; Correll, 1978). Additionally, *H. quinqueseta* has a distinct distribution, occurring in southern North America, Central America, the Antilles, and northern South America, and has never been recorded and is not known to occur in Brazil.

Beyond the species in section *Macroceratitae*, the only other Brazilian species to which *Habenaria pabstii* is similar and could be confused is *H. urbaniana* (sect. *Nudae* Cogniaux). Both species are similar in the large flowers and long and filiform lateral segments of the petals and lip. However *H. urbaniana* is vegetatively taller (86–122 cm high), has lanceolate leaves up to 2 cm wide; a longer (12–19 cm) and many-flowered inflorescence ((6)12 to 25 flowers) with overall smaller flowers with proportionally less developed anterior petals (petals anterior segment 19–33 mm long, 1.6–1.9 times longer than the posterior segment); a shorter floral spur (ca. 2–2.5 cm), which at most equals the ovary plus its pedicel in length, and prominently broadened at the apex (1 mm wide at the base, 3–4 mm wide in the apex). Additionally, the column structure of both species is very different, with the middle lobe of the rostellum of *H. urbaniana* smaller (about 1.5 mm long and 2 mm tall), triangular, and completely enclosed by the anthers. Lastly, plants of *H. pabstii* became black when dried or preserved in ethanol, while those of *H. urbaniana* and the species in section *Macroceratitae* became brown. The identification as *H. candolleana* is unwarranted since this species has much smaller flowers (dorsal sepal and lip lateral segments 6–8 mm long), and a very distinct column structure.

In column structure, mainly in relation to the rostellum morphology, *Habenaria pabstii* is very similar to *H. johannensis*. In both species, the rostellum mid lobe forms a prominent tunnel-like structure, which is partially erect and projected beyond the anthers (Fig. 2B, 2C). Despite this morphological similarity, it is not known, and would be interesting to investigate, whether both species share any similarities in their mechanisms of pollination.

Paratypes. BRAZIL. **Distrito Federal:** Gama, Saia Velha, 22 Mar. 1961, *Heringer 8123* (AMES, HB, NY); Sobradinho, Paranoazinho stream, 9 Jan. 1966, *Irwin et al. 11505* (HB, NY, UB); Núcleo Bandeirante, Vargem Bonita, 5 Feb. 1966, *Irwin et al. 12301* (HB, NY); Núcleo Bandeirante, Mansões Setor Park Way, 14 Jan. 1996, *Batista & Oliveira 585* (CEN); Brasília, University of Brasília farm, 5 Jan. 1989, *Bianchetti & Salles 743* (CEN); Brasília, Setor de Mansões do Lago Norte, 14 Jan. 1992, *Batista 231* (CEN); Brasília, near Colorado gas station, 10 Feb. 1991, *Batista 185* (CEN); Brasília, Lago Sul, QI-17, 16 Feb. 1995, *Oliveira 93* (UB). **Goiás:** Mun. Alto Paraíso, Chapada dos Veadeiros, 9 Feb. 1966, *Irwin et al. 12382* (HB, NY, UB); 20 km N of Alto Paraíso, 1250 m, 19 Mar. 1971, *Irwin et al. 32181* (HB, NY, UB); GO-118, ca. 26 km N of Alto Paraíso, 13°58′S, 47°27′W, 8 Feb. 1987, *Pirani et al. 1889* (SPF); Alto Paraíso/Colinas do Sul, ca. 3 km of GO-118, 1200 m, 14°09′22″S, 47°32′43″W, 27 Jan. 1997, *Walter et al. 3636* (CEN); Corumbá de Goiás, 14 Jan. 1968, *Irwin et al. 18598* (HB, NY, UB); Caldas Novas, 12 Jan. 1981, *Menezes in CFCR 642* (SP, SPF); Pirenópolis, Santuário Ecológico do Morro do Cabeludo, 22 Jan. 1995, *Batista 504* (CEN); Minaçu, 29 Jan. 1997, *Assis et al. 404* (CEN, SPF); Mun. Cavalcante, ca. 17 km SO of Cavalcante, 8 Jan. 2001, *Batista & Pansarin 1137* (CEN, UEC).

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Felicia fischeri (Asteraceae) Refound in Northwest Tanzania

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ABSTRACT. *Felicia fischeri* from Tanzania has been treated as a probable synonym of *F. welwitschii* for the last 50 years; the syntypes had been lost. Recent collections from northern Tanzania show that it is a species in its own right.

Key words: Asteraceae, Compositae, *Felicia*, Tanzania.

Hoffmann (1895) described *Felicia fischeri* O. Hoffmann (Compositae: Astereae) from two specimens collected by Fischer in Kagehi, Mwanza District, northern Tanzania, in the early 1880s—the dates are not clear. The syntypes were lost when the Berlin herbarium was bombed in the Second World War. Grau (1973) decided that *F. fischeri* was probably synonymous with *F. welwitschii* (Hiern) J. Grau, a species otherwise known from the far south of Tanzania, southern Congo (Kinshasa), and south to Angola and Zimbabwe. The epithet *welwitschii* is of a slightly later date (1898), but as the types of *F. fischeri* were lost, Grau treated the earlier *F. fischeri* as a doubtful synonym of *F. welwitschii*. In the *Flora of Tropical East Africa* (Beentje, 2002), I agreed with Grau.

Over a century after the original collection, the Tanzanian collectors Festo, Bayona, and Wilbard collected a small Composite in the Minziro Forest Reserve in northwest Tanzania:

TANZANIA. Kagera, Bukoba Rural District, Minziro Forest Reserve, Kakindo Village, SW of forest, altitude 1150 m, rare at forest edge, 01°07′39″S, 31°30′00″E, 1 July 2001, *L. Festo, W. Bayona & W. Wilbard 1572* (NHT, K!, MO); Minziro Forest Reserve, Kalagara-Kayunga Subvillage, near top of hill, altitude 1207 m, occasional in open grassland, 01°03′49″S, 31°32′48″E, 20 July 2001, *L. Festo, W. Bayona & W. Wilbard 1659* (NHT, K!, MO).

The description of these two plants is as follows:

Herb with annual shoots 40–60 cm high from a perennial root; stem unbranched except for the inflorescence, pale green, pilose to thinly pubescent. Most leaves in a sub-rosette near ground level, oblong, 5–11 × 0.4–0.7 cm, base slightly narrowed, margin entire and minutely ciliate to hispidulous, apex obtuse, with sparse scattered tubercle-based hairs; cauline leaves sparse, similar to basal ones but rapidly decreasing in size. Capitula 30 or more in laxly branched bracteate cymes (the proximal part of which is probably a leafy branching), radiate; stalks of individual capitula 6–24 mm long, bracteolate, pubescent; involucre campanulate, 3.5–4 mm long, ± 5 mm diam.; phyllaries 2-seriate, lanceolate, green with pale scarious margin and apex, 2.5–3.8 × 0.4–0.6 mm, with a few scattered hairs. Ray florets 1-seriate, 17–19, whitish, tube cylindrical, ± 2 mm long, glabrous, limb ± 3.7 × 1.4 mm, style 2.5 mm long. Disc florets many, tube ca. 2.3 mm long, lobes ca. 0.8 mm long, glabrous. Achenes compressed, brown with 2 paler margins, 1.2–1.3 mm long, pilose; pappus of ± 15 barbellate bristles 2–2.3 mm long.

Hoffmann's original description of *Felicia fischeri* is: "herbacea ramis hispidulis; foliis alternis sparsis linearibus sessilibus obtusis integerrimis hispidis; capitulis parvulis laxe paniculatis pedicellatis; involucri bracteis pauciseriatis subaequilongis oblanceolatis acutis; ligulis oblongis, achaeniis compressis hirtis; pappi seris 1-seriatis tenuibus longe ciliatis.—Untere B. 3 cm long, 2 mm breit.—17 (Kagehi—*Fischer* n. 371, 336)—Gebirgssteppe."

Hoffmann did not mention the basal rosette, but it is possible that this part was missing from Fischer's specimens; many collectors do not collect the basal parts of Compositae (luckily for us, Festo and his colleagues did!). Otherwise the description, while being rather general, agrees neatly with the recent collections. Kagehi is in Mwanza District, just south of Lake Victoria and not very far from the Minziro Reserve (about 220 km as the crow flies).

The new collections of *Felicia fischeri* differ from *F. welwitschii* sensu stricto in the rosette leaves (*F. welwitschii* has leafy stems with proximal leaves opposite), the phyllaries (2-seriate, not 4-seriate), the number of ray florets (17 to 19, not 25), the smaller disc florets (tube ca. 2.3 mm, not 3.3–4.5 mm long), and the fewer and shorter (2–2.3 mm, not 3–4 mm long) pappus bristles.

I believe these new collections are the taxon that Fischer collected all those years ago, and the recent collections resolve a mystery: *Felicia fischeri* is distinct from *F. welwitschii*, it is a species in its own right, and a rare endemic restricted to northwest

Tanzania and probably the adjacent part of Uganda. I hereby designate the neotype:

Felicia fischeri O. Hoffmann, in Engler, die Pflanzenwelt Ost-Afrikas und der Nachbargebiete C: 407. 1895. TYPE: Tanzania. Mwanza District: Kagehi, *Fischer 336, Fischer 371* (syntypes, B destroyed); Tanzania. Bukoba District: Minziro Forest Reserve, Kalagara-Kayunga Subvillage, 01°03′49″S, 31°32′48″E, 20 July 2001, *L. Festo, W. Bayona & W. Wilbard 1659* (neotype, here designated, K). [Duplicates of the neotype are at NHT and MO but have no official status, according to the *Code* (Greuter et al., 2000); nevertheless, I would call them iso-neotypes. It would have been more appropriate if the neotype had been the top specimen, deposited at the National Herbarium of Tanzania, rather than the third set deposited at Kew, but the Kew sheet was the specimen studied.]

The conservation status of *Felicia fischeri* should probably be Data Deficient (DD); the habitat, open grassland, is probably still common, but the species seems to be rare within this habitat. I have no information on threats to the vegetation of this area.

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Nomenclatural Novelties in the Orchidaceae from Venezuela and Guyana

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ABSTRACT. The following represent new specific taxa in the Orchidaceae from Venezuela: *Epidendrum cesar-fernandezii* Carnevali & I. Ramírez, *E. reclinatum* Carnevali & I. Ramírez, *Pleurothallis loreae* Carnevali & I. Ramírez, *P. escalerensis* Carnevali & C. A. Luer, and *P. stellata* I. Ramírez & Carnevali. A new nothospecies, *Epidendrum* ×*gransabanensis* Carnevali & I. Ramírez, is proposed as the product of the introgression between *Epidendrum ibaguense* HBK and *E. secundum* Jacquin. A new subspecies, *Liparis nervosa* subsp. *granitica* Carnevali & I. Ramírez, is proposed to accommodate populations of *Liparis nervosa* (Thunberg) Lindley restricted to granitic outcrops in the northwestern Guayana in Venezuela. Descriptions, illustrations, and discussions of affinities are provided for the newly proposed taxa.

Key words: *Epidendrum*, Guyana, *Liparis*, Orchidaceae, *Pleurothallis*, Venezuela.

Field and herbarium studies of Venezuelan Orchidaceae relevant to several floristic projects, primarily the treatment for the *Flora of the Venezuelan Guayana* project (Carnevali et al., 2003), have uncovered several new taxa. These orchid taxa are herein proposed as new.

SUBTRIBE LAELIINAE

Epidendrum cesar-fernandezii Carnevali & I. Ramírez, sp. nov. TYPE: Venezuela. Táchira: along road between Rubio and Delicias, 25 km above Rubio, SW of Rubio, 23 Aug. 1976, *T. Croat & G. Bunting 38489* (holotype, VEN; isotype, MO, isotype fragment, CICY). Figure 1.

Species haec *Epidendro goodspeediano* A. D. Hawkes similis sed floribus multiminoribus; *E. agoyanense* et *E. aguaricoense* affinis sed ovario sepaloque verruculosis differt; *E. densifloro* affinis sed labello latiore, petalis pendulis recedit.

Epiphytic *herbs*, to 2 m tall; *roots* unknown; stems simple, multifoliate, slightly compressed, to 15 mm thick near apex; apical *leaves* 12–17 cm long, 15–25 mm wide, elliptic, acute, acuminate, margin entire; sheaths 5–6 cm long, tubular, smooth; *inflorescence* 35–55 cm long, terminal on the mature stem without a spathe, flowering once, paniculate, the primary branches pinnate again in the lower ¼ of their length; peduncle 2–4 cm long, subterete or slightly compressed, surface smooth in the lower ⅓, becoming laxly verruculose above; primary branches 25–30 cm long, secondary branches 3–5.5 cm long bearing 5 to 8 flowers; bracts of the peduncle 8–11 cm long, ca. 1 cm wide at base, very narrowly triangular and acuminate, bracts of the primary branches similar to those of peduncle but much smaller, 3–5 cm long; rachis on the branches subterete and slightly angulate, laxly verruculose; floral bracts 3.8–4.1 mm long, ca. 1 mm wide, narrowly triangular; *flowers* resupinate, relatively small for the group; sepals green, suffused with honey brown on the apical half, petals translucent green, the labellum white, suffused with pink and some areas with a green hue around the edges of the callosities, column pale pink on the apical half, the basal half dull dark green with dull maroon tinges dorsally and where it joins the lateral sepals; *sepals* widely spreading, fleshy, slightly concave along the midnerve on the apical half, dorsally conspicuous and coarsely verruculose; dorsal sepal 11–12 × 2.8–3.1 mm, elliptic spathulate, obtusely acute, 5-nerved; lateral sepals 9–11 × 3.5–4 mm, elliptic spathulate, obtusely acute, 6-nerved, subapically with fleshy, conical, acute mucro 1 mm long; *petals* 9.8–10.2 mm long, 0.9 mm wide at apex, 0.3 mm wide at the base, thin, flexed downward and pendent behind the lateral sepals, 1-nerved, filiform-oblanceolate, rounded to broadly obtuse at apex, margin entire; *labellum* 5.9–6.1 × 8.9–9.2 mm across the forcefully spread lateral lobes, convex in natural position, fused up to the apex of the column, the margins finely fimbriate, in general outline transversely oblong elliptic, apically conspicuously but shallowly emarginate, the disk

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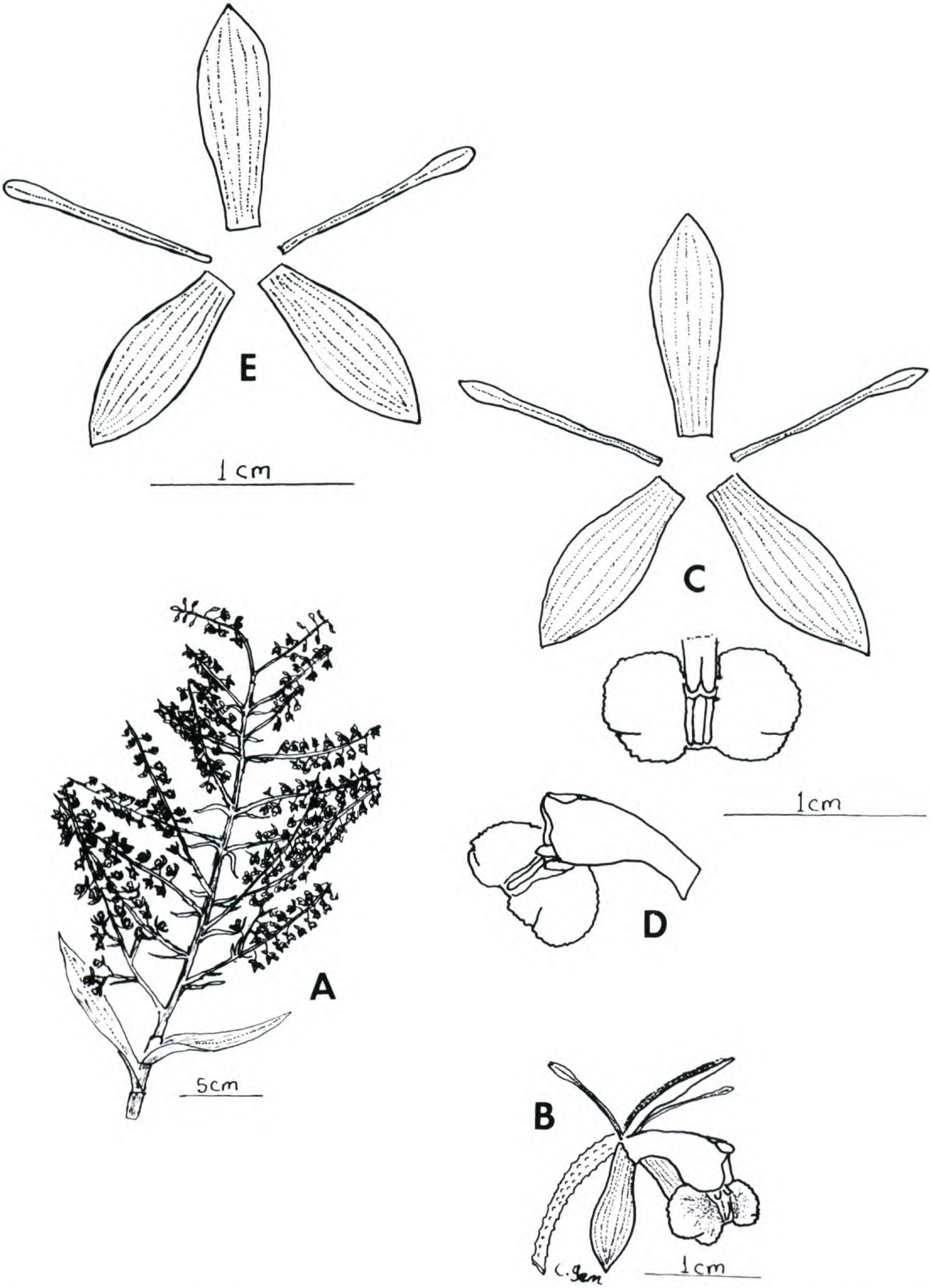


Figure 1. *Epidendrum cesar-fernandezii* Carnevali & I. Ramírez. —A. Habit. —B. Flower in natural position. —C. Floral parts, flattened with labellum. —D. Column and labellum. —E. Floral parts flattened showing different petal shape. (Based on isotype, *T. Croat & G. Bunting 38489*, MO.) Drawing by Carlos Yam.

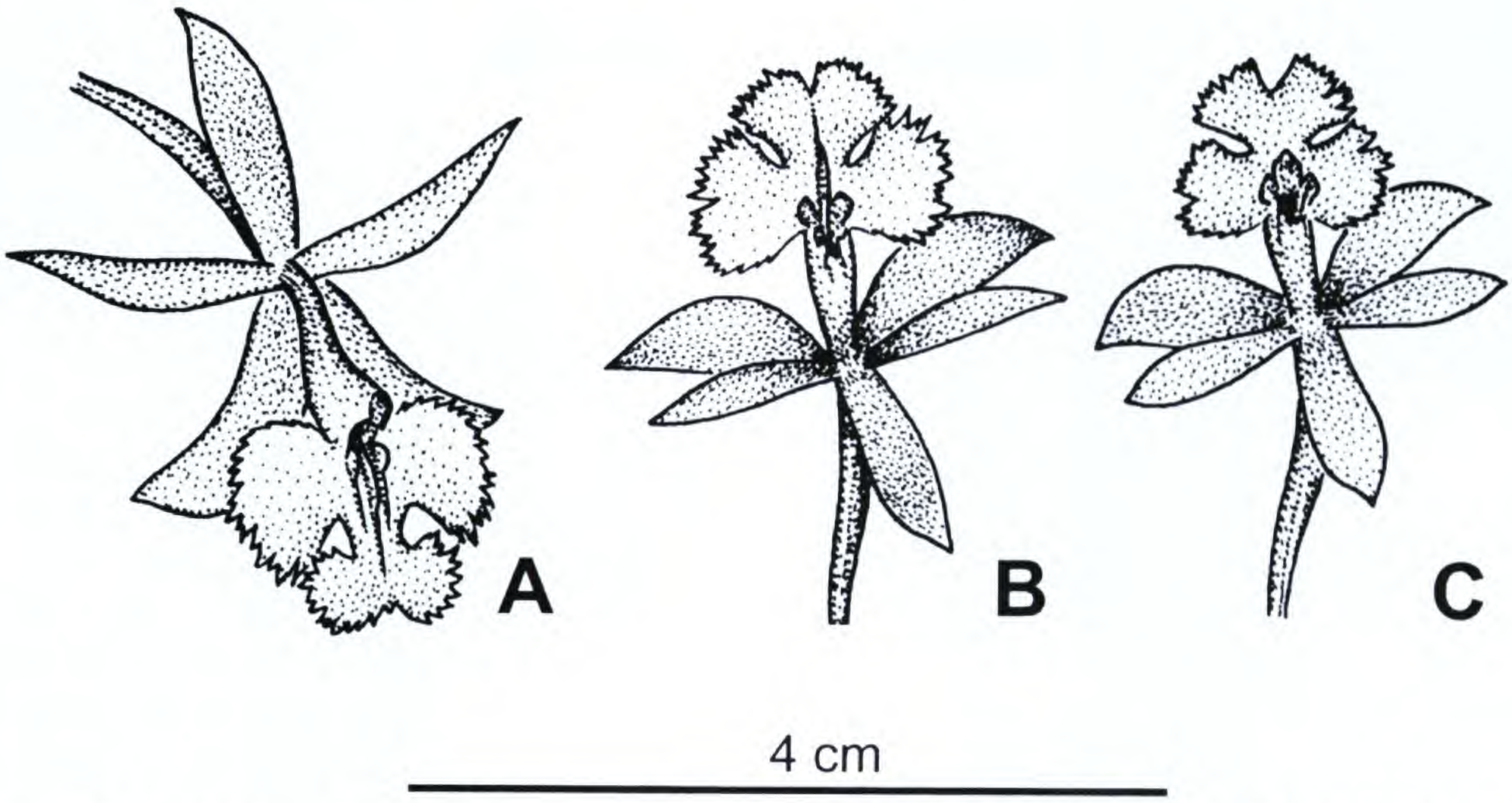


Figure 2. —A. *Epidendrum ibaguense* (based on *Carnevali et al. 3241*, VEN; 70% EtOH CICY). —B. *Epidendrum* ×*gransabanensis* Carnevali & I. Ramírez (based on *Carnevali et al. 3239*, VEN; 70 % EtOH CICY). —C. *Epidendrum secundum* (based on *Carnevali et al. 3240*, VEN; 70% EtOH CICY). Drawings by Bruno Manara.

bicallose, with 3 prominent blunt keels that run up to the apex of the labellum, the one in the middle thicker and higher; the whole blade 4-lobed, the basal lobes 4.4–4.6 mm long, reniform, basally cordate, the apical lobes ca. 3.5 mm long, ca. 2 mm wide, transversely reniform or subquadrate, the apices diverging, the basal margins separated from the basal lobes by very narrow sinuses or fused to them; *column* 7.5–8 mm long including the clinandrium, ca. 3.5 mm thick at apex; clinandrium obsolete, margin entire; anther ca. 2 mm long, ovoid-subspheric, 4-locular, pollinia 4 of the "bird-wing" type, strongly compressed laterally, the inner ones somewhat smaller and partially fused on their ventral surface, caudicles smooth, soft, viscidium transparent; rostellum subapical, cleft, nectary shallow.

Etymology. The specific epithet refers to César Fernández, a collector of the paratype of the species and an active researcher of the Venezuelan Andean orchid flora. The hyphen in the epithet is to be maintained, according to Article 60.9 of the ICBN (Greuter et al., 2000).

This new species is similar to *Epidendrum densiflorum* Hooker, but the labellum is proportionally wider, the margins are more erose, and the ovary and outer faces of the sepals are more verruculose. The petals are pendulous in the new species whereas they are spreading in *E. densiflorum*. The large plants and the general structure of inflorescences and flowers suggest an affinity with the Ecuadorian *Epidendrum agoyanense* Hágsater & Dodson and *E. aguaricoense* Hágsater & Dodson, but these species, also from the eastern Amazonian slopes of the Andes, feature labella with entire margins and much more divaricate apical lobes. *Epidendrum goodspeedianum*, from the western Andes, is also similar but it is a much larger plant and has larger flowers than *E. cesar-fernandezii*, with the labellum more than 2.5 cm wide and pedicels of up to 6 cm long.

Paratype. VENEZUELA. **Táchira:** Mun. Junín, El Playón, 1115 m, 3 Aug. 2001, *C. Fernández 0341* (VEN).

Epidendrum ×gransabanensis Carnevali & I. Ramírez, nothospecies nov. TYPE: Venezuela. Bolívar: road El Dorado–Santa Elena de Uairén, km 138 S of El Dorado, Canaima National Park, NE Gran Sabana general area, approx. 6°19′N, 61°25′W, shrublands over sandy soils along the road, in a mixed mosaic along with gallery forests, sandstone outcrops, and boggy associations, 1500 m, 3 Aug. 1993, *G. Carnevali, F. Lorea, N. Warford, B. Whitlock, R. Rivero, W. Díaz & C. Fleming 3238* (holotype, VEN; isotype, CICY [70% EtOH]). Figure 2.

Hybrid formula: *Epidendrum ibaguense* HBK × *Epidendrum secundum* Jacquin.

Nothospecies intermedia quam *Epidendrum ibaguense* et *E. secundum*; haec *Epidendro ibaguensi* similis sed floribus non resupinatis, sepalis petalisque proportione latiore brevioribus, callo crassiore, columna breviore recedit.

Terrestrial *herbs*; growing over sandy soils, sun-loving; stems, leaves, and inflorescences indistinguishable from those of *Epidendrum ibaguense*, *flowers* non-resupinate or rarely resupinate, petals

and sepals widely spreading, purple, labellum purple with a yellow callus; *dorsal sepal* 11.5–12.5 × 3.1–3.5 mm, narrowly elliptic, acute; *lateral sepals* 12–13 × 3.7–4 mm, elliptic, oblique, acute; *petals* 10–11 × 2.3–2.8 mm, narrowly elliptic, acute; *labellum* cordiform in general outline, with the margins irregularly dentate to erose or even laciniate, flat, 7.5–8 mm long from the apex of the column, 3-lobed, 13.5–14 mm wide across the apices of the lateral lobes; central lobe 3.7–4 × 8.5–8.7 mm, broadly obovate, apically emarginate; lateral lobes reniform, 0.5–0.66 mm long and wide, flabellate obovate; disk with a pair of laminar, obovate calli at each side of the apex of the column and that can be interpreted as being a continuation of it, and a laminar keel running down the center; *column* straight, 0.55–0.65 mm long.

This new entity is almost certainly the result of the introgression of *Epidendrum ibaguense* and *E. secundum*. Both taxa grow on rocky, exposed places, in a landscape of a mixed mosaic of savanna with gallery forests over sandy, acidic soils along the road from El Dorado to Santa Elena de Uairén, the former at low elevations (800–1000 m), the latter at relatively higher elevations (1000–1300 m). Mixed populations of both parental taxa and the hybrid taxon are common at intermediate altitudes. *Epidendrum* ×*gransabanensis* was treated as *Epidendrum ibaguense* × *Epidendrum secundum* in Carnevali and Ramírez (in Carnevali et al., 2003: 338).

Epidendrum ibaguense and related taxa, e.g., *E. splendens* Schlechter, *E. radicans* Lindley, *E. macrocarpum* Richard, *E. calanthum* Reichenbach f. & Warscewicz, and others, are characterized by resupinate flowers and a simple callus consisting of two laminar projections at each side of the apex of the column often joined with two small, globular or obovate-laminar, keel-like calli at the base of the disk, and a central laminar keel running down the center, rarely to the apex of the emargination of the central lobe, but more often ending midway along the isthmus of the central lobe. This thin laminar keel frequently curves or waves one way or the other. The column is usually relatively long, as long as or longer than the blade of the labellum. The perianth segments are of a relatively soft texture. A few taxa of this complex, e.g., *E. mimeticum* Carnevali & G. Romero, *E. flexuosum* G. Meyer, and clones of *E. radicans*, consistently feature non-resupinate flowers, but are otherwise clearly members of this grouping when other morphological traits (e.g., callus, labellum, and perianth segment shape) are taken into account.

On the other hand, members of the extremely difficult *Epidendrum secundum* complex, e.g., *E. catillus* Reichenbach f. & Warscewicz, *E. elongatum* Jacquin, *E. jamesonii* Lindley, *E. tricallosum* Schlechter, etc., feature non-resupinate flowers and a complex callus composed of several to many tubercles and thick, intertwined keels, and a relatively short column, usually shorter than the labellum blade and much shorter than the petals and sepals. Further, the lateral lobes of the labellum appear to originate from the sides of the apex of the column, not from an independent, free, laminar blade, as is the case in the labella found in the members of the *E. ibaguense* complex. Good illustrations of members of this complex (probably several species on the same plate) are to be found in Dunsterville and Garay (1979: 224, plate 187) as *E. elongatum*. Good color photographs of members of the *E. ibaguense* and the *E. secundum* complexes of the Guayana are found in Couret (1982) and Romero (1997). In this paper, we follow the approach taken by Carnevali and Ramírez (in Carnevali et al., 2003: 342–343) in treating most members of this complex as a single entity, *Epidendrum secundum*. The group of taxa around *E. secundum* requires an urgent revision to ascertain their boundaries and distributions. In the meantime, it is safest to treat them as a single, widely ranging, and variable species.

Within the mixed population in the general Gran Sabana area in Venezuela mentioned above, colonies of plants that are intermediate between species of the two complexes are commonly found. On occasion, isolated plants featuring intermediate combinations of characters are also encountered in a landscape of a mixed mosaic of savanna with gallery forests. These putative hybrid plants are characterized by non-resupinate flowers (reminiscent of *E. secundum* parentage) and a simplified callus (from the *E. ibaguense* parentage) consisting of two thick lateral calli following the lateral, apical edges of the column, and a laminar keel running down the center. This laminar keel is thicker and proportionally shorter than those found in the members of the *Epidendrum ibaguense* complex.

The two specimens cited in this protologue represent two extremes in labellum shape variation within the nothospecies, though both display non-resupinate flowers. The holotype corresponds to an individual showing an *E. ibaguense*-type labellum, which is, however, somewhat broader and shorter. On the other hand, Figure 2B depicts a second plant of this grex (*G. Carnevali et al. 3239*), which features a more *E. secundum*-like labellum, but with simplified calli. Both were collected along the

El Dorado–Santa Elena de Uairén road growing within a perimeter of a couple of meters and along with many other plants showing various combinations of parental characters. Populations of both *E. ibaguense* and *E. secundum*, both in pure stands or in mixed communities, were found nearby. We decided to name these apparent hybrids since they are a common sight along the road and are becoming increasingly common in both herbarium and live collections. The introgression between the two species in the general Gran Sabana area is apparently associated with disturbed, anthropogenic conditions. This situation has probably created novel microhabitats for the survival of the hybrids, or more likely, has somehow allowed for the breakdown of former pollination barriers between members of the *E. ibaguense* and *E. secundum* populations. A more thorough sampling program is required to ascertain whether the introgression process is restricted to disturbed areas close to roads or human settlements, or if it occurs elsewhere, under more pristine conditions.

An additional taxon, recently described as a species, but not mentioned as a nothospecies, is probably also the result of the introgression of members of the *Epidendrum ibaguense* and *E. secundum* complexes. This is *Epidendrum thermophilum* Hágsater & Dodson (Hágsater & Dodson, 1993) from northwestern Ecuador. This entity features non-resupinate, small red-purple flowers with the overall morphology of an intermediate between the two complexes. The labellum is shallowly 3-lobed with the simpler callus of the *E. ibaguense* complex. *Epidendrum calanthum* (a member of the *E. ibaguense* complex with small, pink, soft-textured flowers with an almost simple labellum) grows nearby, and some members of the *E. secundum* complex must occur in the immediate neighborhood, since populations of these species (such as *E. jamiesonis* Reichenbach f.) are locally common in open places in the Andean slopes, e.g., *D. Rubio & C. Quelal 692*, MO). It would appear that non-resupination is a dominant feature in hybrids involving members of both complexes.

Paratype. VENEZUELA. **Bolívar:** locality same as the holotype, *G. Carnevali et al. 3239* (VEN, CICY [EtOH]).

Epidendrum reclinatum Carnevali & I. Ramírez, sp. nov. TYPE: Guyana. Mazaruni-Potaro: Guyana–Venezuela border area, Roraima summit, la Proa Camp, E of border, near Lake Gladys, mostly open rocky areas with ravines and lake, 5°15′36″N, 60°13′00″W, 2800 m, 14 Apr. 1988, *R. Liesner 23315* (holotype, VEN; isotypes, CICY, MO). Figures 3, 4.

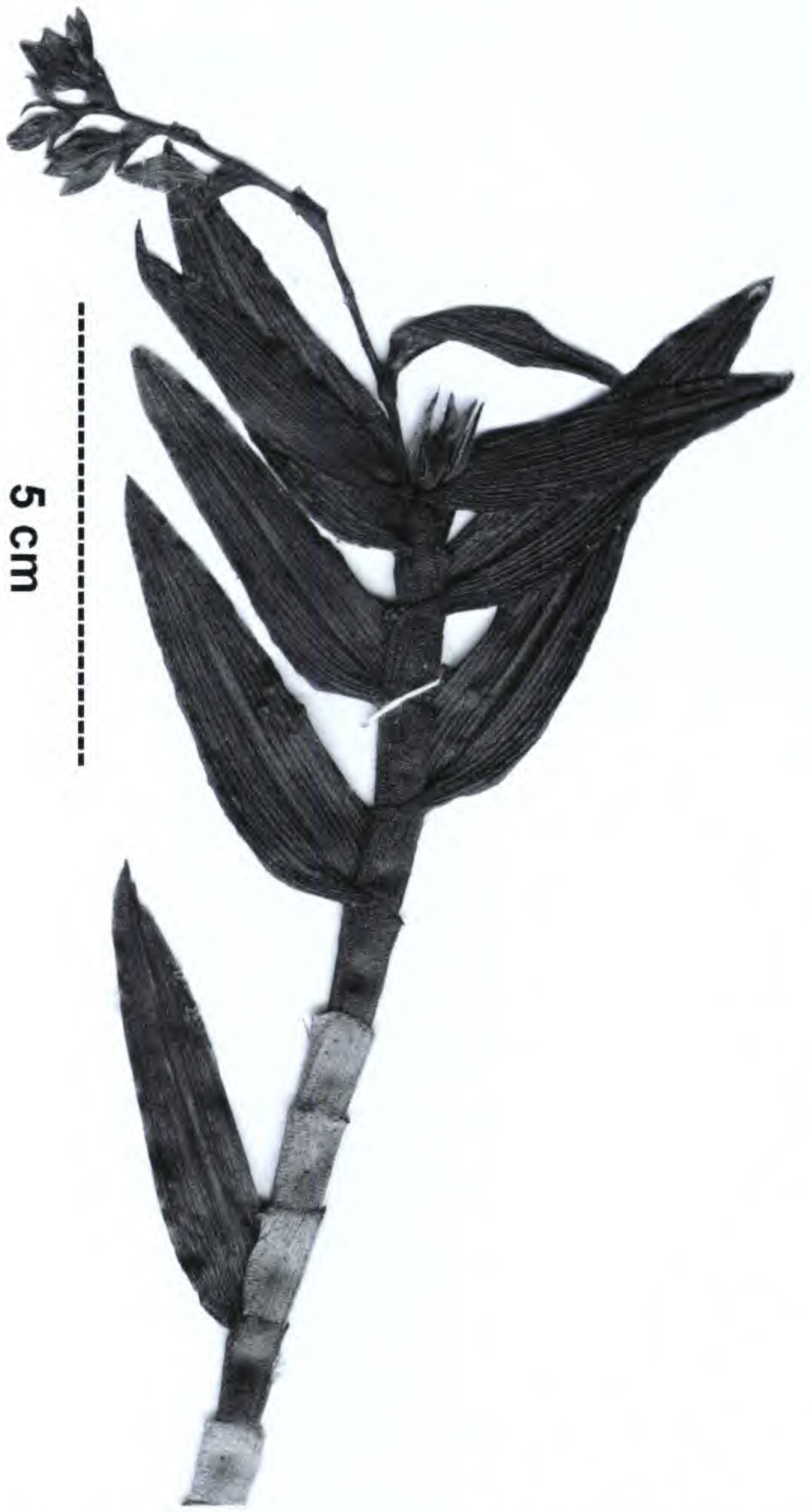


Figure 3. *Epidendrum reclinatum* Carnevali & I. Ramírez. Habit (based on *F. Delascio-Chitty 13972*, VEN; digital scan by Germán Carnevali).

Species haec *Epidendro montigeno* similis sed plantis prostratis, bracteis majoribus, floribus albidis vel flavidis, petalis proportione latioribus recedit.

Terrestrial herbs, prostrate, sprawling and creeping, growing on grassy or boggy areas, drying dark brown to black with an oily sheen; *roots* carnose, 1–2 mm thick; *stems* (7–)10–20(–35) cm long, 0.4–0.6 mm thick, totally clothed by sheaths; rooting at the base and above as it sprawls over the substrate; foliose from the base when young, eventually leaves restricted to the upper half or third of the stem, simple at first, then branching after flowering; branches occurring at several levels on the stems, often about mid-length of the flowering stem, 7–13 cm long; *leaves* 3.5–5 cm long, 8–11 mm wide on flowering stems, smaller on young stems or branches, narrowly ovate, acute to subacuminate, margins revolute, minutely erose toward the apex, entire

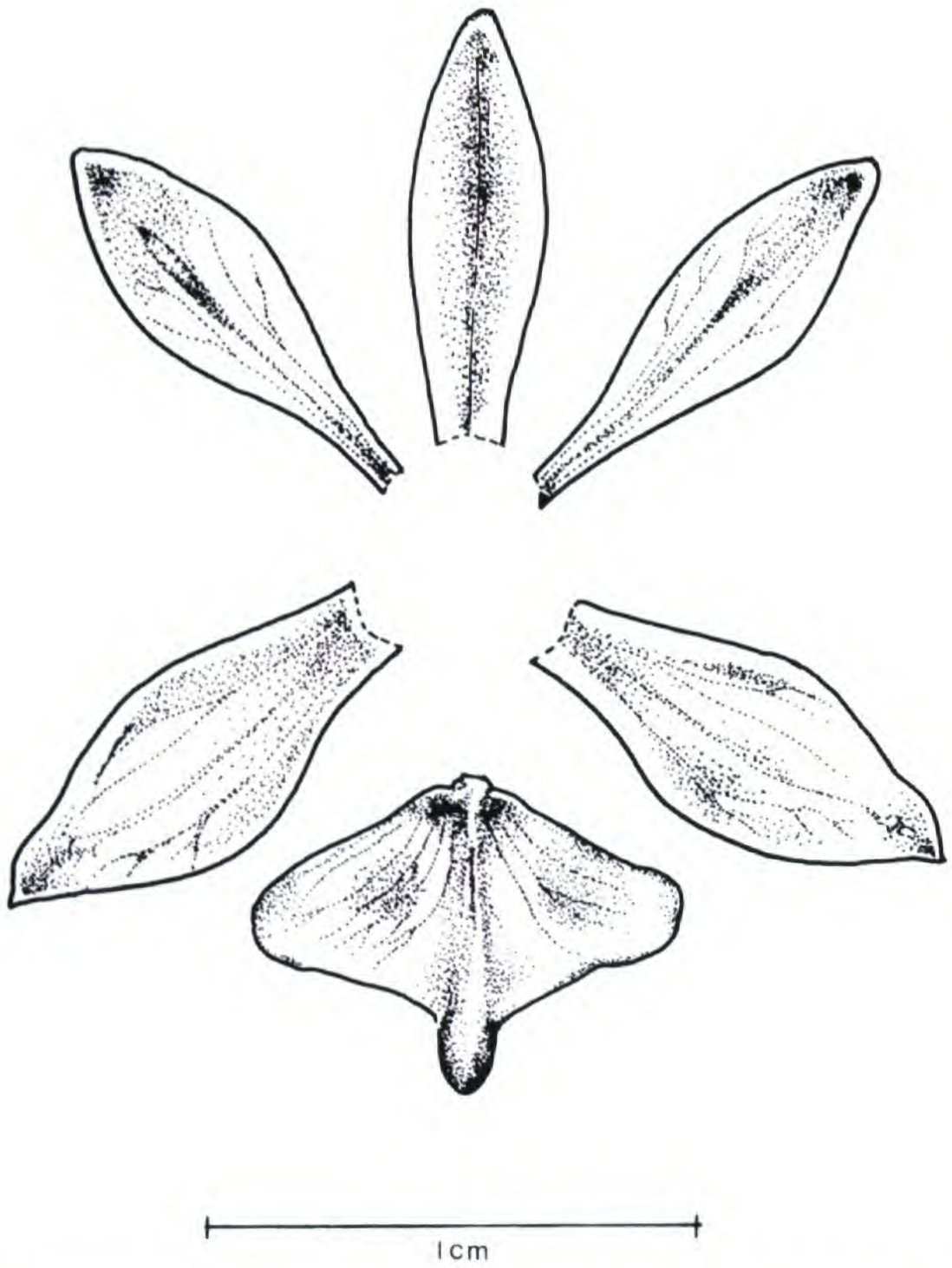


Figure 4. *Epidendrum reclinatum* Carnevali & I. Ramírez. Floral parts flattened (based on holotype, *R. Liesner 23315*, VEN). Drawing by Rossana Marrufo.

elsewhere; blades articulate with their sheaths, conspicuously striate and minutely cross-veined in dry material, all in one plane, sheaths 10–20 mm long, tubular, scarious, rugulose; *inflorescences* terminal from the main stems or the branches, racemose, 3–7 cm long, 6- to 8-flowered, lacking a spathe; peduncle 2.5–3 cm long; rachis 3–4 cm long, erect or apparently nutant; floral bract 6–9 × 3–5 mm, surpassing the pedicellate ovary at anthesis, cucullate, fleshy; *flowers* white or yellow-tinged, fleshy, apparently non-resupinate; *pedicellate* ovary 4–5 mm long; *sepals* concave, fleshy, dorsal sepal 7–8 × 2.5–2.7 mm, elliptic-oblong, obtuse, dorsally keeled, 3- to 5-nerved; lateral sepals 7.9–8.1 × 4–4.5 mm, broadly elliptic, oblique, obtusely acute margins concave, erose particularly toward the apex, 3- to 5-nerved; *petals* 6.5–8 × 2.1–2.6 mm, narrowly spathulate, elliptic, apically broadly obtuse to subacute, margins erose, 1- to 3-nerved; *labellum* fleshier than other perianth segments, entire, deeply concave in natural position, fused to the column to its apex, the free portion 8–9 mm long from the insertion of the sepals and labellum, 6.5–8 mm wide when forcefully spread, transversely rhombic, the apex very fleshy, obtuse-acuminate, 1.2–1.5 mm long; *column* 3.5–4 mm long, ca. 2.5 mm thick, the clinandrium and anther smooth.

Epidendrum reclinatum is one of several taxa in the *Epidendrum dendrobioides* Thunberg complex, a group of taxa that has undergone extensive diversification in the Guayana Highlands, although several species of the group grow elsewhere. The complex is characterized by its mainly terrestrial or lithophytic habit (often at high elevations), usually on exposed, rocky or boggy conditions, the stems usually branching about mid-length, the fleshy flowers that are often campanulate, the relatively large, fleshy floral bracts, and the simple, deeply concave, often unspreadably fleshy labellum. Among other taxa in the complex, *E. reclinatum* is readily recognized by the prostrate, sprawling stems and short unbranched inflorescences. It is apparently most closely related to the sympatric or parapatric *Epidendrum montigenum* G. S. Ridley ex Oliver, with which it shares the softly fleshy flowers, the labellum being spreadable (though somewhat forcefully) in herbarium material. It is, however, easy to distinguish from that taxon by its white or yellowish flowers (vs. pink), the prostrate habit, the broader petals, and the more transverse labellum. This species was treated in Carnevali and Ramírez (in Carnevali et al., 2003: 345) as *Epidendrum* sp. A.

Several taxa in this complex are found sympatrically or parapatrically in the Roraima-Tepui massif, where *E. reclinatum* seems apparently restricted. Among these, *Epidendrum alsum* G. S. Ridley, *E. montigenum*, and this new taxon are endemic there. The several taxa of the *Epidendrum dendrobioides* complex occurring in the Venezuelan Guayana can be distinguished with the use of the following key.

KEY TO THE MEMBERS OF THE *EPIDENDRUM DENDROBIOIDES* COMPLEX OF THE VENEZUELAN GUAYANA

1. Inflorescences shorter than the leaves; labellum longer than wide . . . . . *E. imthurnii* Ridley
1′. Inflorescences longer than the leaves; labellum as broad as or broader than long 2
2(1). Flowers pale to deep pink; labellum fleshy coriaceous, flexible and thus easily flattened, thicker toward base . . . . . *E. montigenum*
2′. Flowers green, yellowish or cream-colored; labellum very fleshy (rarely fleshy coriaceous in *E. reclinatum*), rigid and impossible to flatten without breaking it, thicker toward the apex . . 3
3(2). Plants prostrate, sprawling and creeping over boggy substrate; plants apparently restricted to Roraima tepui and surrounding massifs (Ilú Tepui, Kukenán Tepui) . . . . . *E. reclinatum*
3′. Plants erect, rarely weakly prostrate over shrubs on tepui shrublands; plants of many places in the Guayana Highlands 4
4(3). Floral bracts 9–13 mm wide (since they are

conduplicate, the width of one half can be doubled for easy measurement) 5
4′. Floral bracts 3–7(–8) mm long 7
5(4). Floral bracts 3–4 times longer than the pedicellate ovary . . . . . *E. urbanianum* Cogniaux
5′. Floral bracts shorter, up to 2 times longer than the pedicellate ovary 6
6(5). Inflorescences strictly erect, unbranched; rachis straight; leaves acute; floral bracts with straight apices; dorsal sepal 11–12 mm long; petals 10–12 mm long; plants from Cerro de La Neblina . . . . . *E. commelinispathum* Carnevali & I. Ramírez
6′. Inflorescences arching, decurving or pendent, often branching; rachis zigzag; leaves obtuse; dorsal sepal 6–7 mm long; petals 4.5–5.5 mm long; plants from Roraima and neighboring tepuis . . . . . *E. alsum* G. S. Ridley
7(5). Dorsal sepal 5–7 mm long, 1.9–2.1 mm wide; labellum 4–4.5 mm long, 6–7 mm wide . . . . . *E. durum* Lindley
7′. Dorsal sepal 8–9 mm long, 4–4.5 mm wide; labellum 5–5.5 mm long, 7.5–9 mm wide . . . . . *E. ulei* Schlechter

Paratypes. VENEZUELA. **Bolívar:** Roraima, NE sector, Lago Gladys, 2700 m, 3–5 Apr. 1989, *F. Delascio-Chitty 13972* (VEN); Ilú-tepui, lower plateau, 2500 m, 16 Apr. 1988, ". . . sterile, decumbent spreading . . . ," *R. Liesner 23431* (CICY, MO, VEN); Kukenán Tepui summit, 17 Apr. 1988, *R. Liesner 23452* (MO, VEN).

Tribe Malaxideae

Liparis nervosa (Thunberg) Lindley, Gen. Sp. Orch. Pl. 26: 1830. *Ophrys nervosa* Thunberg ex Murray, Syst. Veg. (ed. 14): 814. 1784. TYPE: Japan. *Thunberg s.n.* (UPS not seen).

Liparis nervosa is widespread in the Neotropics and tropical Africa and Asia. For such a widespread taxon there seems to be little variation in flower shape. However, there is much vegetative variation, and some forms might merit subspecific recognition. One such distinctive series of populations is here treated at the subspecific level. Another set of Guianas plants with different floral coloration is discussed here in relation to the other subspecific taxa considered.

Liparis nervosa subsp. **granitica** Carnevali & I. Ramírez, subsp. nov. TYPE: Venezuela. Bolívar: 1 km S of Quebrada La Flore, affluent of Río Ore, affluent of Río Parguaza, 85 m, 9 Sep. 1985, *Julian A. Steyermark, Bruce Holst & Bruno Manara 131667* (holotype, VEN; isotype, MO). Figure 5.

Species haec *Lipari nervosae* subsp. *nervosae* affinis sed plantis et floribus minoribus, foliis angustioribus, acutis, habito graniticola recedit.

Lithophytic, growing on cracks of rocks on vertical granite walls. *Pseudobulbs* ovoid, 1–2 cm long, entirely concealed in shredded-nerved formless bracts; *leaves* 2(to 4) per pseudobulb, narrow to rarely wide-elliptic to ovate-elliptic, acute, basally attenuate into a pseudopetiole; laminae with 5 longitudinal nerves, prominent, (3–)5(–8) cm long, (1.6–)2.9(–3.9) cm wide, membranaceous, pale yellow-green, usually erect. *Inflorescence* terminal, erect to pendulous, apical, 8–14 cm long, a raceme, usually 3-flowered to rarely 9-flowered; peduncle pinkish (fide *Steyermark et al. 131667*). *Flowers* small as compared to other members of the species, yellow (fide *Steyermark et al. 131667*), arranged from the mid-point to the apex of the inflorescence. Sepals and petals membranaceous, labellum curved backward. Sepals oblong, 7 × 3 mm, with 5 nerves, apically oblique, rounded, margins entire. Petals narrowly elliptic, apically rounded, 9 × 2 mm, margins entire. *Labellum* 2-lobed, in general shape obovate, strongly decurved, 5.1 mm long, 4.1 mm wide, apically notched, with a small mucro, 5-nerved, three central and two lateral from where reticulate nerves expand to the margins, margins crenulate, with a 1.5 mm claw at the base of labellum from which two small (0.5 mm long) apical horn-like calli project. Column strongly incurved

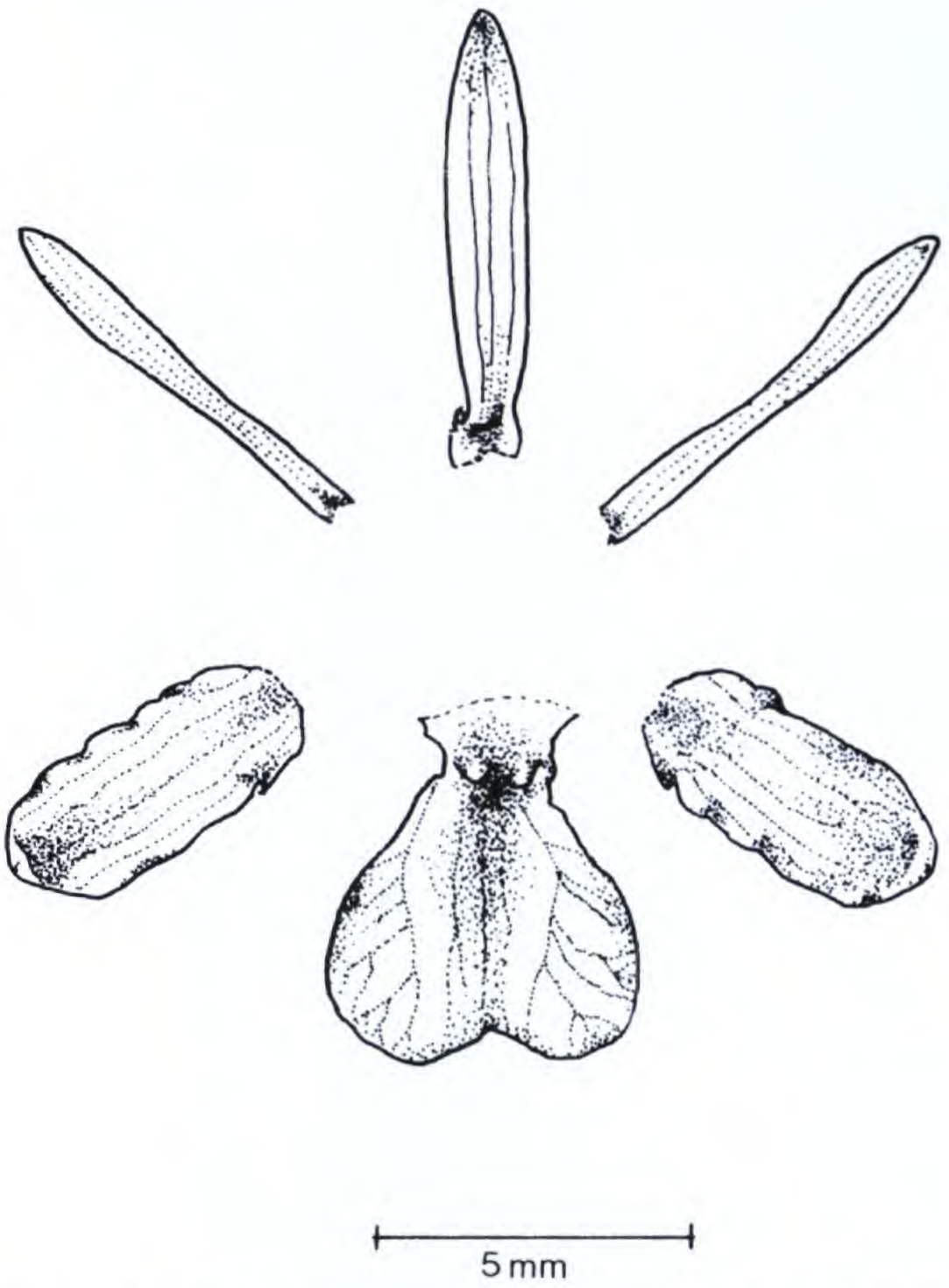


Figure 5. *Liparis nervosa* subsp. *granitica* Carnevali & I. Ramírez. Floral parts flattened (based on *Julian A. Steyermark et al. 131667*, VEN). Drawing by Rossana Marrufo.

apically, 4.5 mm long, with two small wings, 0.4 mm long.

Paratype. VENEZUELA. **Amazonas:** Mun. Atures, carretera Pto. Ayacucho–Samariapo, km 12.5, 100–150 m, 29 July 1993, *A. Gröger 1034* (MO, VEN).

This entity is known from few collections and grows in seasonally dry areas in environments that are usually much drier than those where the typical subspecies for *Liparis nervosa* grows. It was treated as *Liparis nervosa* subsp. A in Carnevali and Ramírez (in Carnevali et al., 2003: 413). Although similar to the typical subspecies, the plants of the new subspecies are smaller (see key below), and the leaves are narrower ((1.6–)2.9(–3.9) cm vs. usually more than 4 cm in the typical subspecies) and dry a distinctive pale yellow-green or pale yellow-brown color. The inflorescence is also proportionally shorter. The flowers are somewhat smaller (dorsal sepal up to 7 mm long as opposed to ca. 8 mm in the typical subspecies) but otherwise identical to those of the typical subspecies. More material may indicate that this entity should be recognized at the species level. This new subspecies is locally abundant on granitic outcrops in northern Amazonas State and northwestern Bolívar State in Venezuela (possibly ranging into neighboring Colombia). There it grows on shady, rocky vertical walls or otherwise under the shade of shrubs. On the other hand, the typical subspecies is usually found growing on soil, often in boggy places or as subepiphytes in extremely humid places and not in dry, rocky places.

Liparis nervosa f. **kappleri** (Reichenbach f.) Christenson & Carnevali, Lindleyana 11: 17. 1996. *Sturmia kappleri* Reichenbach f., Linnaea 22: 833. 1849. *Leptorchis kappleri* (Reichenbach f.) Kuntze, Revis. Gen. Pl. 671. 1891. *Liparis kappleri* (Reichenbach f.) Reichenbach f., Ann. Bot. Syst., 6: 218. 1864. TYPE: Surinam. Feb.–Apr. 1844, *Kappler 1491* (MO).

This entity is rare and so far only known from the type collection (Christenson, 1996). However, since it is likely to appear elsewhere in the Guianas and the Venezuelan Guayana, we have included it in this account. It seems to be nothing more than an anthocyanin-free form of this species (Christenson, 1996). *Liparis nervosa* f. *kappleri* seems to be a distinctive morph of the typical subspecies, and should stand as a good taxon. However, more material may indicate closer affinities with subspecies *granitica* than with the type of the species.

The following key allows the identification of the infraspecific taxa of *L. nervosa* in the Guianas.

KEY TO THE INFRASPECIFIC TAXA OF *LIPARIS NERVOSA* IN THE GUIANAS

1a. Leaves (3–)5(–8) cm long, (1.6–)2.9(–3.9) cm wide, usually narrowly elliptic, membranous, pale yellow-green upon drying; inflorescences 8–14 cm long . . . . . *L. nervosa* subsp. *granitica*

1b. Leaves usually longer than 8 cm in mature plants, often 10–30 cm long, usually broader than 4 cm, often to 10 cm wide; usually elliptic, of a firmer texture, drying greenish or brownish; inflorescences (7–)10–30(–50) cm long; leaves drying several shades of brown . . . . . *L. nervosa* subsp. *nervosa*

2a. Flowers tinged with purple or brown . . . . . *L. nervosa* f. *nervosa*

2b. Flowers entirely greenish yellow . . . . . *L. nervosa* f. *kappleri*

SUBTRIBE PLEUROTHALLIDINAE

Pleurothallis loreae Carnevali & I. Ramírez, sp. nov. TYPE: Venezuela. Falcón: Sierra de San Luis, Zambrano–Curimagua road, cloud forests over karst, 1300–1500 m, 9 Aug. 1993, *G. Carnevali, F. Lorea, N. Warford, B. Whitlock & F. Morillo 3263* (holotype, VEN; CICY [EtOH, flower]). Figure 6.

Species haec *Pleurothalli chamae* affinis, sed plantis floribusque minoribus, sepalis dorsalibus 3-nervis, labello profunde concavo abhorret; affinis *P. cordatae* sed sepalo dorsali proportione angustiore, labello concavo, petalis carnosioribus glabris recedit.

Lithophytic, sun-loving, cespitose *herbs*; rhizome abbreviated; *stems* erect, straight, terete, 11–19 cm long, with two sheaths shorter than internodes, the shorter one basal, the longer at stem mid-point, sheaths 1.5–3.2 cm long, margins entire; *leaves* 6.5–6.7 × 2.9–3.2 cm, coriaceous, ovate, basally cordate, basal lobes overlapping by 1.5 mm, apically long attenuate, acute; *inflorescences* emerging from two fibrous sheaths, fascicles of 4 or 5 flowers, 1 or 2 open at a time; pedicels ca. 2 mm long; pedicellate ovary 2.5 mm long, slightly verrucose; *flowers* fleshy, resupinate, concave, basically deep wine-purple, the sepals marginally somewhat orange-yellow, the petals and labellum rich purple-red; sepals concave, thick, the margins incurved and minutely verruculose; *dorsal sepal* 5.5 mm long, 3.5 mm wide when expanded, elliptic-oblong, obtuse, 3-nerved; lateral sepals totally connate into a synsepal 4.4–4.6 × 6.4–6.6 mm when expanded, widely ovate in general outline, fleshy, with 6 nerves, apically notched; *petals* 3–3.1 × 1.1–1.2 mm when deliberately expanded, thickly fleshy and concave, narrowly elliptic, acute, falcate, margins

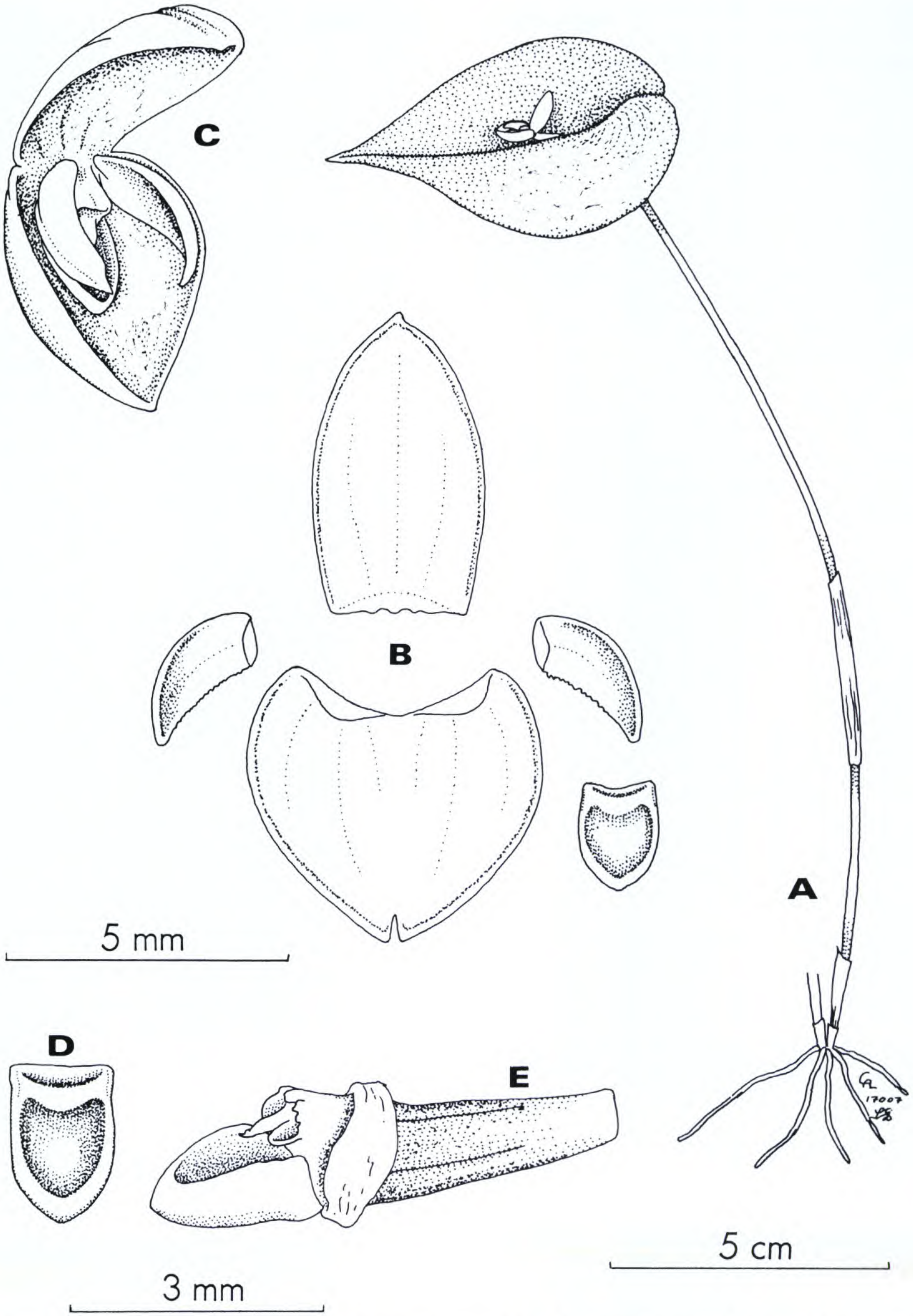


Figure 6. *Pleurothallis loreae* Carnevali & I. Ramírez. —A. Habit. —B. Floral segments flattened. —C. Flower in natural position. —D. Labellum. —E. Column with labellum attached. (Based on the holotype, *G. Carnevali et al. 3263*, CICY, VEN.) Drawing courtesy of C. A. Luer, sketch #17007.

minutely crenate-denticulate, 1-nerved; *labellum* 1.9–2.1 × 1.2–1.4 mm, thick, oblong-ovate in general outline, apically rounded to broadly obtuse, with a central depression, with a transversal ridge near base below which it is shallowly concave; *column* 1.2–1.4 mm long, proportionally short as compared to labellum.

Etymology. Named after Francisco Lorea Hernández, curator at the herbarium of the Instituto de Ecología, A.C., Xalapa, Mexico (XAL), and a specialist in the Lauraceae, who participated in the collection of the type specimen.

This species is vegetatively identical to *Pleurothallis cordata* (Ruiz & Pavón) Lindley, a taxon widespread from Bolivia to Venezuela. In the new species, however, the petals are thicker, falcate, glabrous, and the labellum is ventrally concave. Florally and vegetatively it seems closest to *P. chama* Luer, known from Ecuador. The Ecuadorian species is a much larger plant (stems to 19 cm long in *P. loreae* vs. up to 20–35 cm in *P. chama*) with larger flowers (dorsal sepal 5.5 mm long in *P. loreae* vs. 12 mm long in *P. chama*), featuring a 7-nerved dorsal sepal (vs. 3-nerved in *P. loreae*), and a flat or convex, papillose labellum (vs. deeply concave, glabrous in *P. loreae*).

Pleurothallis loreae is one of several distinctive endemic orchids of the Sierra de San Luis in northwestern Venezuela. Other endemics occurring there include *Masdevallia garciae* Luer, *Pleurothallis sanluisii* Foldats, *Pleurothallis transversilabia* Carnevali & I. Ramírez, *Prosthechea garciana* (Garay & Dunsterville) W. Higgins, *Stelis sanluisensis* Foldats, and several other still undescribed orchid taxa.

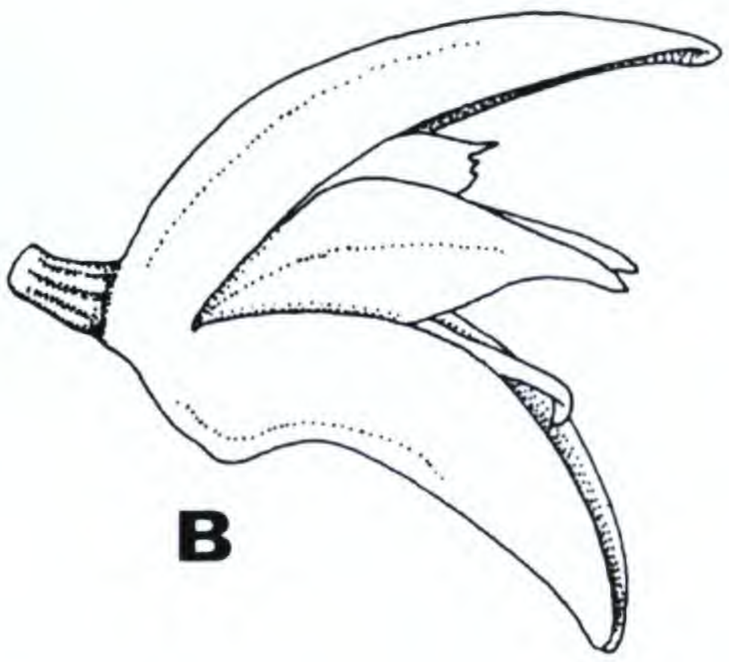
Pleurothallis escalerensis Carnevali & C. A. Luer, sp. nov. TYPE: Venezuela. Bolívar: carretera El Dorado–Santa Elena de Uairén, km 95 al S of El Dorado, light forest over granitic outcrops, 300–400 m, 20 June 1994, *G. Carnevali, W. Fritz & C. Coleman 3672* (holotype, VEN [EtOH]). Figure 7.

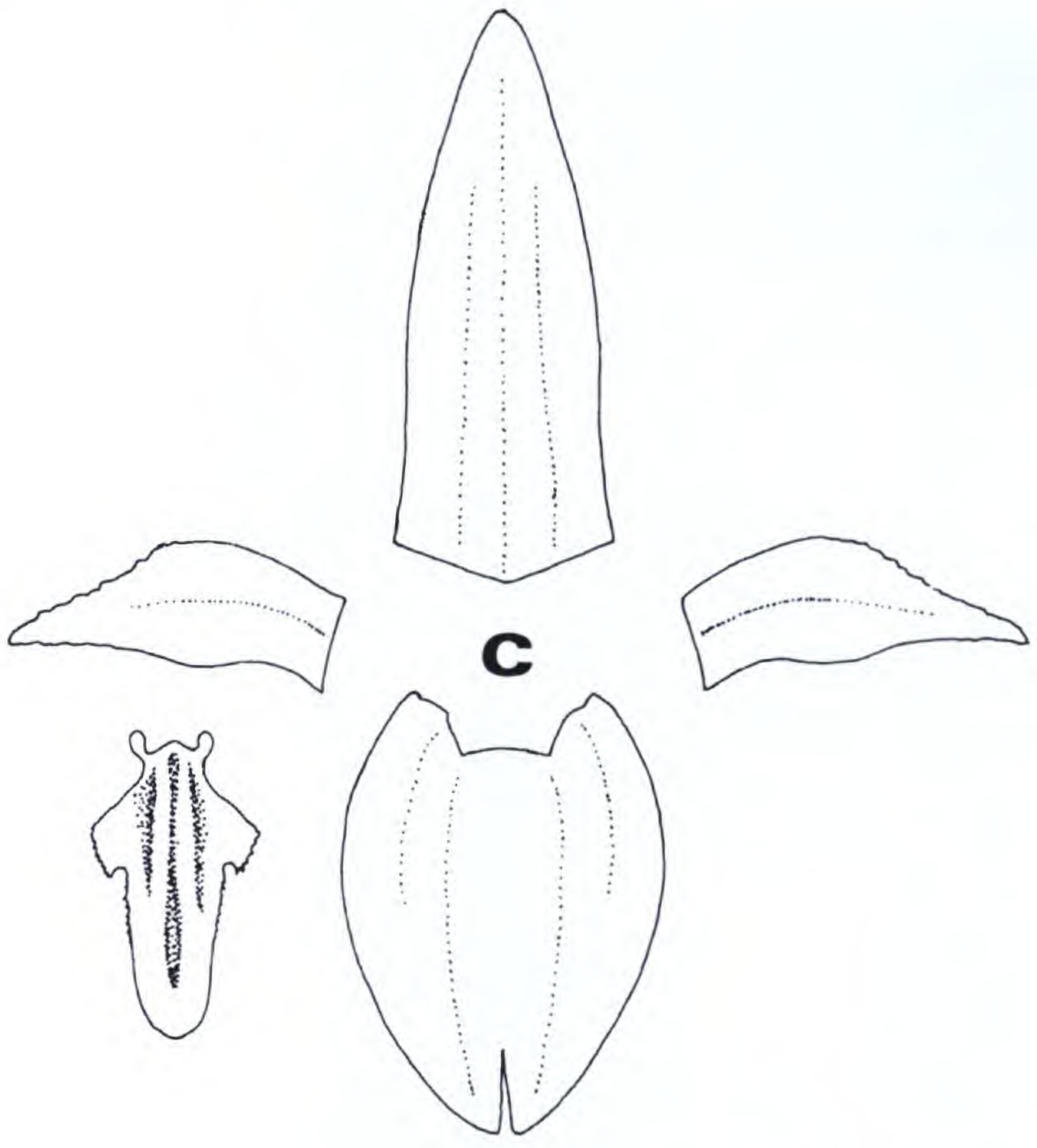
Species haec *Pleurothalli barbulatae* similis, sed inflorescentia multilongiore, rachi laxiore, labello glabro, trilobato, lobis lateralibus falcatis, truncatis, praemorsis recedit.

Minute, shortly creeping epiphyte, 2.5–3.5 cm tall counting the inflorescences; stems 2–3 mm long, clothed by 1 or 2 scarious sheaths; leaves 9–11 mm long, ca. 3 mm wide, coriaceous, spathulate, rounded to broadly obtuse apically, basally attenuate into a short pseudopetiole ca. 1 mm long; inflorescences 17–27 mm long, much surpassing the subtending leaf, erect, successively 4- to 11-flowered, rachis somewhat zigzag; pedicels 1–1.5 mm long, ovary ca. 0.75 mm long, flowers resupinate, campanulate, pale hyaline purple with darker nerves; dorsal sepal 2.4–2.6 mm long, ca. 1.5 mm wide, lanceolate, acute, 3-nerved; lateral sepals fused for more than ¾ of their length into an elliptic synsepal 2.5–2.6 mm long, ca. 2 mm wide, the synsepal concave, at base forming a shallow mentum (a conspicuous, somewhat chin-like convexity seen from below at the base of the synsepal), apically somewhat deflexed; petals 1.9–2.1 mm long, elliptic-rhomboid, obliquely deflexed, acuminate, 1-nerved; labellum 3-lobed just below the middle, 1.7–1.9 mm long, 1–1.1 mm wide across the spread lateral lobes, central lobe 0.9–1.1 × 0.5–0.55 mm, oblong-lanceolate, margins smooth, the apex somewhat deflexed, lateral lobes ca. 0.25 mm long and wide, erect in natural position, porrect, sub-triangular, the apex truncate, the margins erose-fimbriate, the disk with a longitudinal depression reaching to ca. 5/6 of the total length of the labellum, the truncate base hinged to the column foot, with a pair of retrorse basal lobules; column 1.4–1.6 mm long, apically with a pair of broad smooth wings, the clinandrium irregularly 3-dentate, the foot ca. 0.8 mm wide.

This new taxon belongs in *Pleurothallis* subg. *Specklinia* sect. *Muscosae* Lindley, as circumscribed by Luer (1986). If the recent classification by Pridgeon and Chase (2001) were followed, this species would fall within the circumscription of *Anathallis* Barbosa Rodriguez. This complex includes, among others, the following species in the Venezuelan Guayana: *P. aondae* Carnevali & G. Romero, *P. barbulata* Lindley, *P. hilariana* Carnevali & G. Romero, *P. minima* C. Schweinfurth, *P. steinbuchiae* Carnevali & G. A. Romero, and now the novelty here proposed. Among the many taxa of section *Muscosae*, *Pleurothallis escalerensis* is close to *P. barbulata* and *P. aondae*, but in those species the labellum is simple, thus lacking the subtriangular lateral lobes; these two species also have an abbreviated, straight rachis, condensed within several large bracts or spathes, which are otherwise absent in this novelty. The general aspect of leaves and inflorescence suggests a relationship with *Pleurothallis cuspidata* Luer, found from Panama to Ecuador, but in this species all perianth segments are long acuminate and the plants are conspicuously larger (with leaves 3–4 cm long vs. 0.9–1.1 mm long in *P. escalerensis*).

Pleurothallis escalerensis is apparently rare, having been found only once in a relatively well-col-





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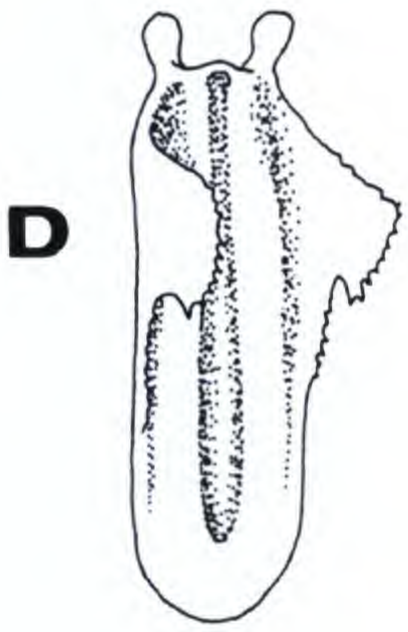

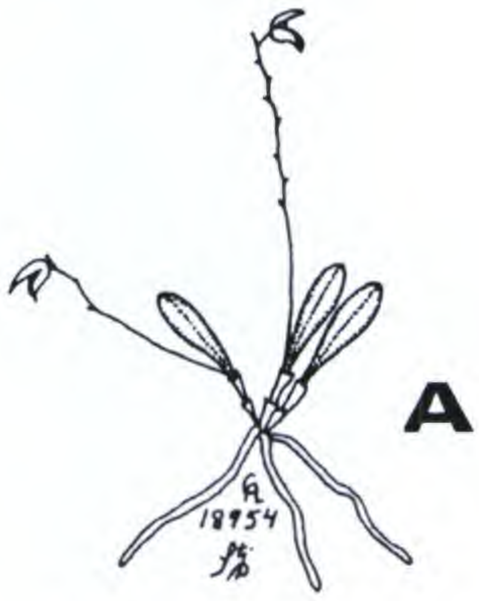

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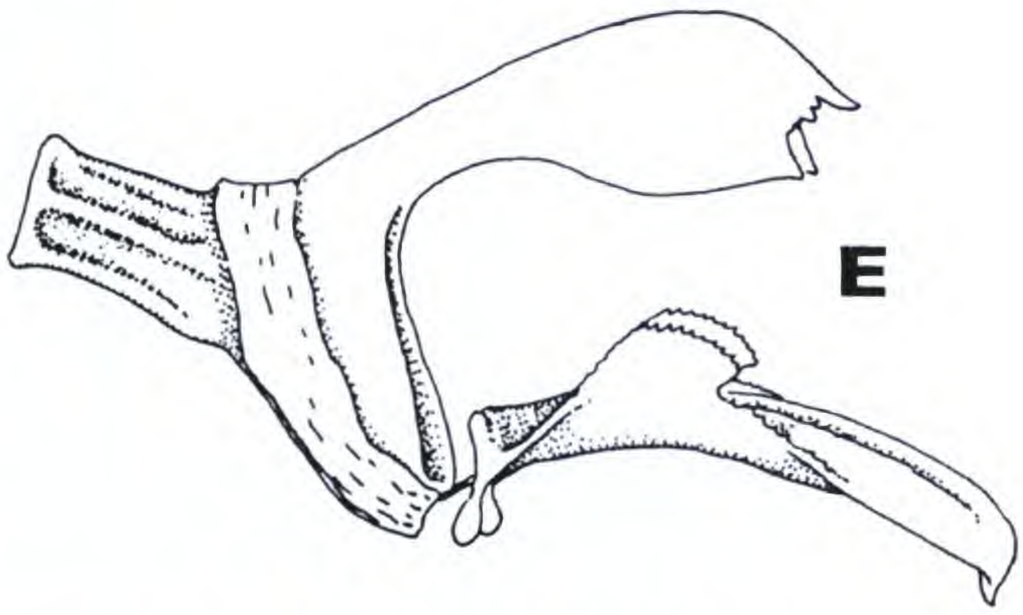
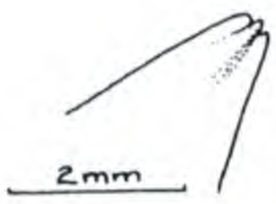
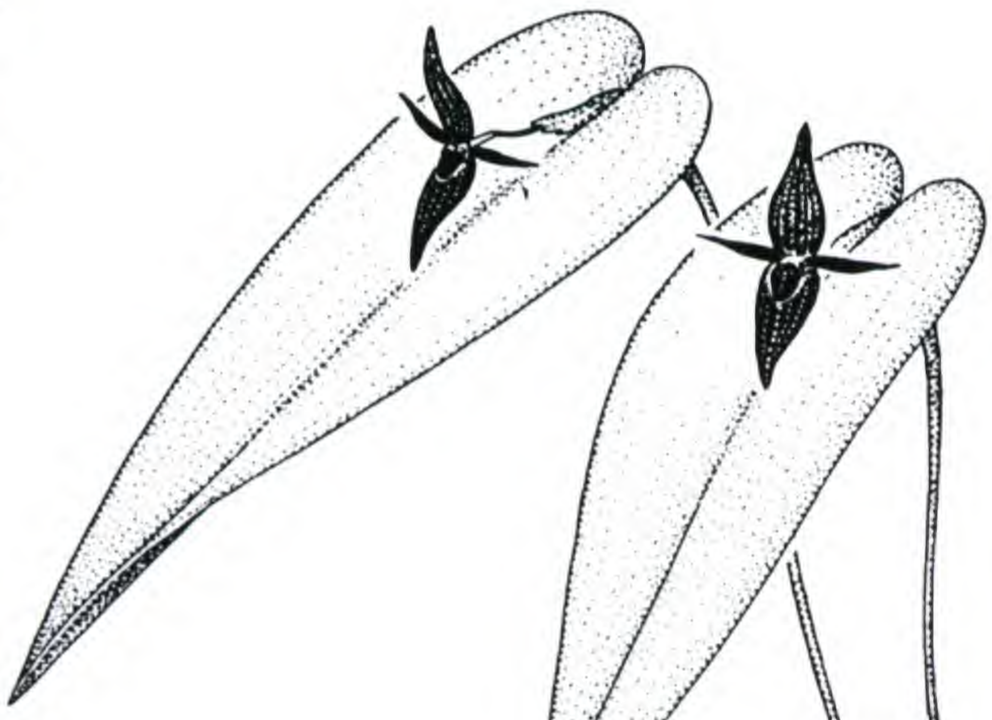
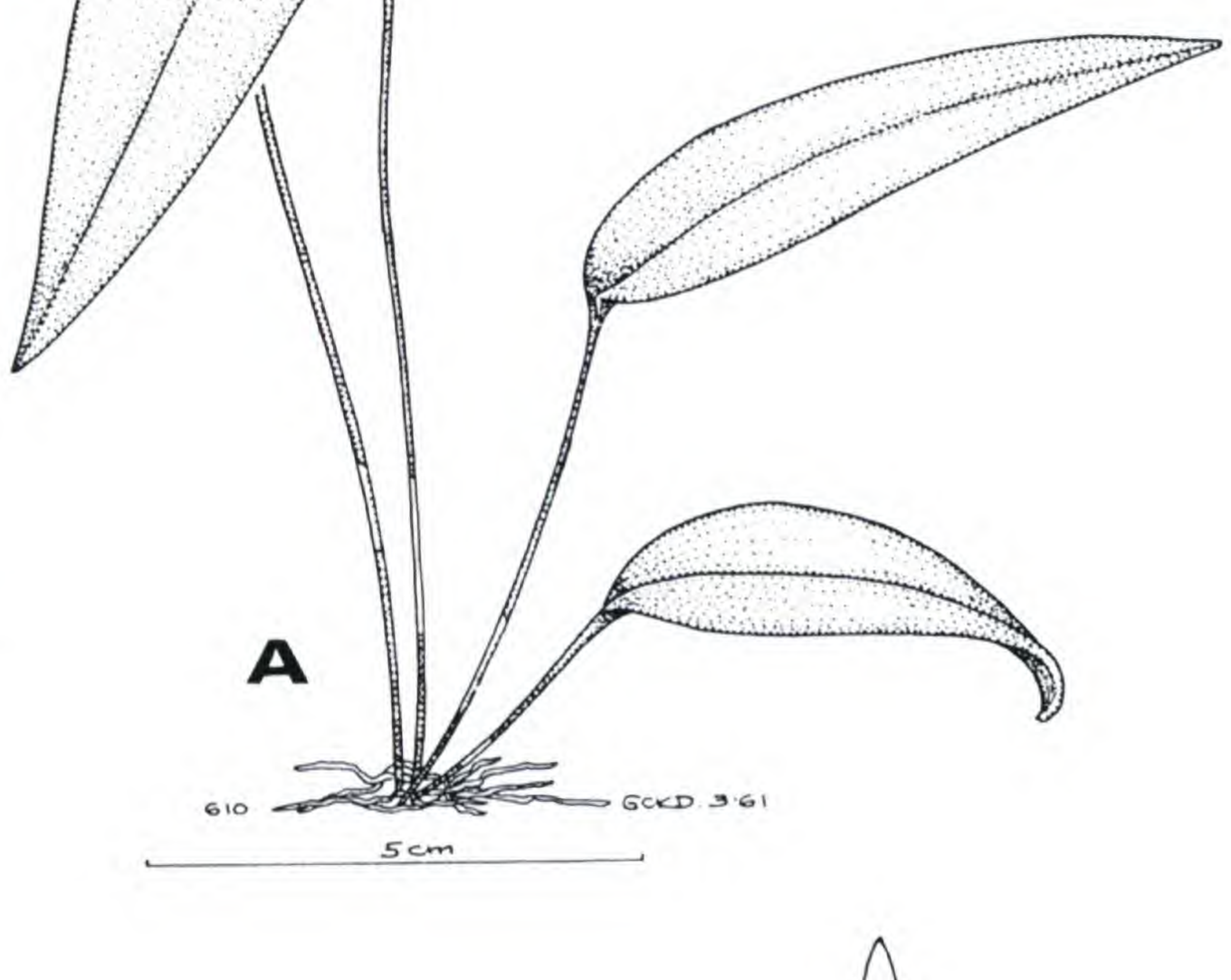


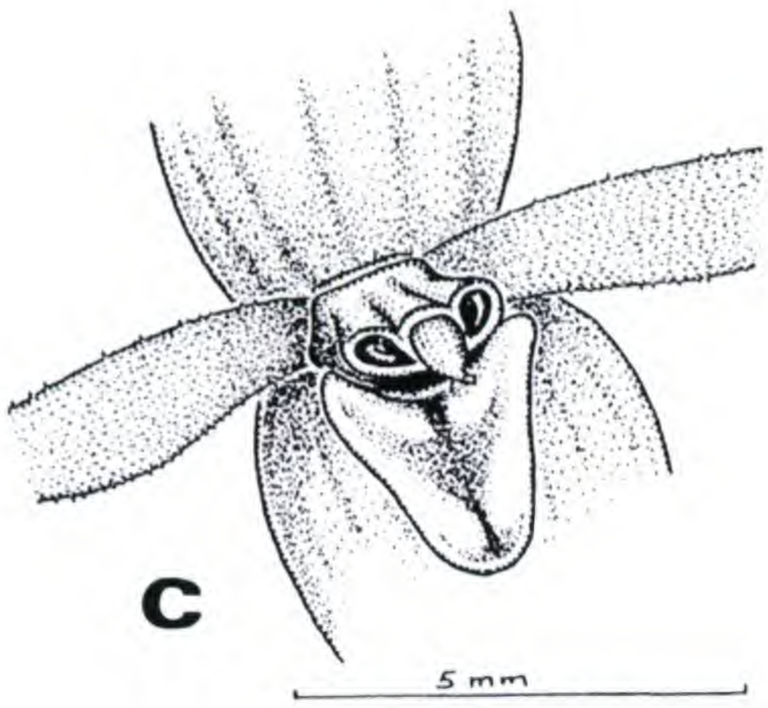
2 mm

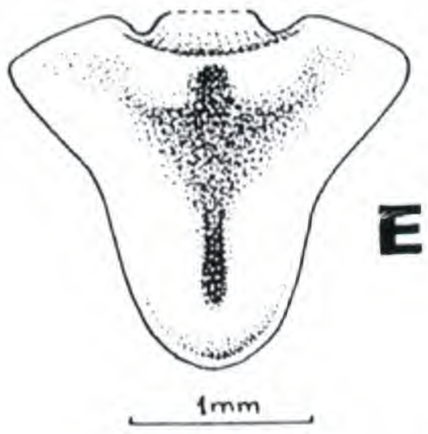
Figure 7. *Pleurothallis escalerensis* Carnevali & C. A. Luer. —A. Habit. —B. Flower in natural position. —C. Floral segments flattened. —D. Labellum. —E. Column with labellum attached. (Based on the holotype, *G. Carnevali et al. 3672*, VEN.) Drawing courtesy of C. A. Luer, sketch #18954.

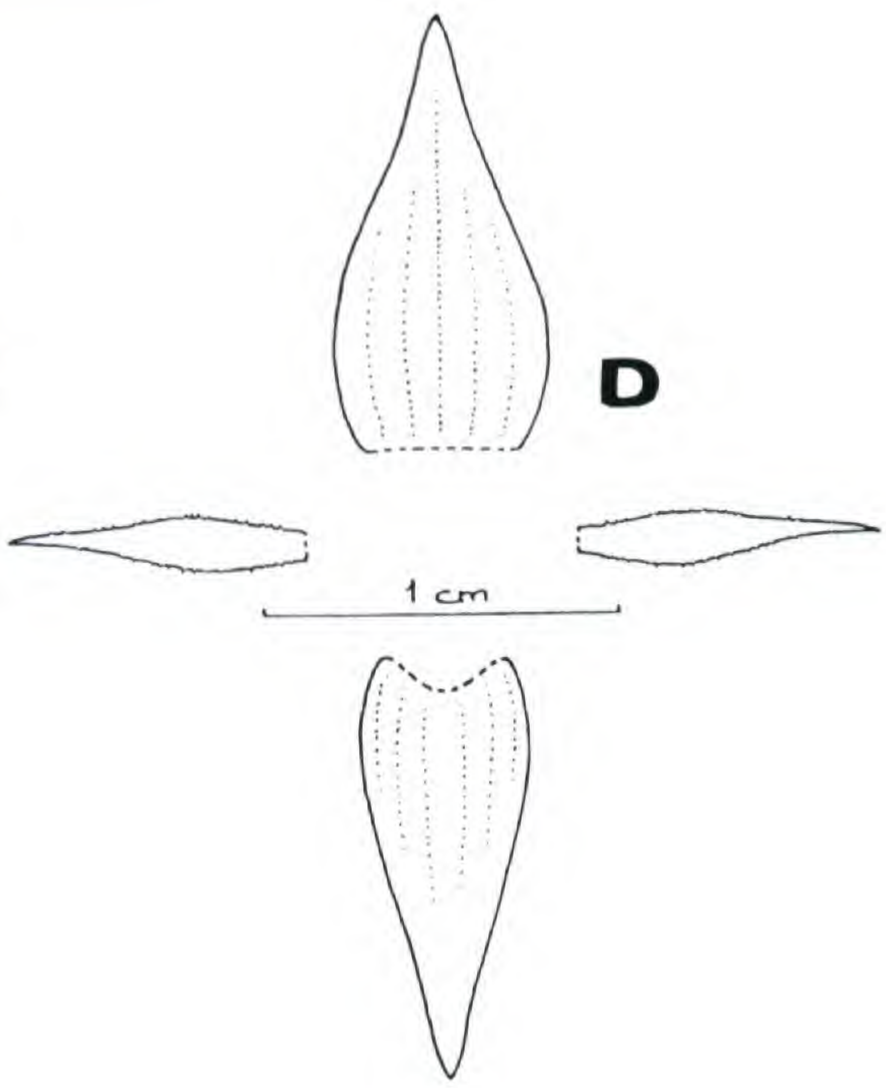












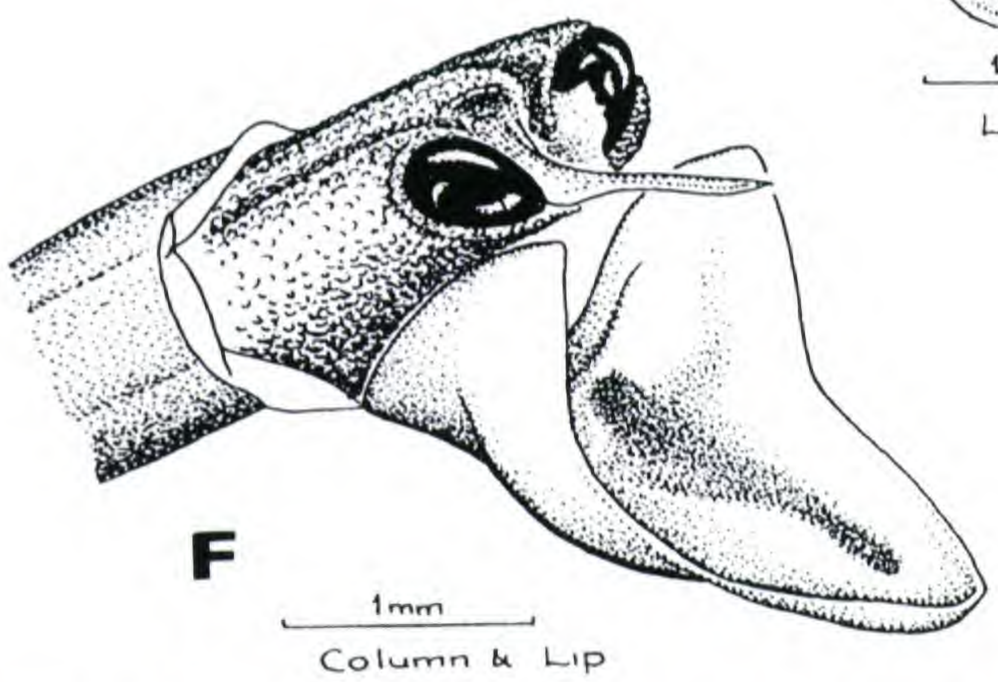


Figure 8. *Pleurothallis stellata* I. Ramírez & Carnevali. —A. Habit. —B. Foliar apex. —C. Detail of open flower, showing labellum and column. —D. Floral segments flattened. —E. Labellum. —F. Details of column, labellum, and anther. —G. Anther and pollinia. (Based on holotype, *G. C. K. Dunsterville 610*, AMES.) Drawing by G. C. K. Dunsterville, sketch #610.

lected area in Venezuela. It may have been overlooked due to its diminutive size. This species was included as "*Pleurothallis* sp. A" in the *Pleurothallis* treatment of the *Flora of the Venezuelan Guayana* (Carnevali & Ramírez in Carnevali et al., 2003: 523). The type locality, i.e., the lower slopes of the Escalera in northeastern Bolívar state at 200–500 m, is a place of high orchid diversity. Here a mixture of tepui species meet their lower altitudinal ranges and grow along with taxa asso-

Table 1. A comparison of *Pleurothallis stellata* and *P. index*.

Feature	*Pleurothallis stellata*	*Pleurothallis index*
Leaf shape	narrowly ovate	ovate
Leaf base	with non-overlapping basal lobes	basal lobes overlapping for 1 cm or more
Leaf dimensions and proportions	9 × 2.5 cm; w/l = 0.27	5.5/3; w/l = 0.55 7.5/3.8; w/l = 0.50
Structure subtending inflorescence	a horizontal sheath 2 cm long	a suberect spathe 12–18 mm long, 5 mm wide (as in *P. cardiostola*)
Dorsal sepal	12 × 6 mm; w/l = 0.5	16 × 4 mm; w/l = 0.25
Synsepal	12 × 5 mm; w/l = 0.41	16 × 4 mm; w/l = 0.25
Petals	8.5 × 1.8 mm; w/l = 0.21	15 × 2.2 mm; w/l = 0.14
Labellum	2 × 2 mm; w/l = 1	4.5 × 2 mm; w/l = 0.45
Labellum shape	ovate, sub 3-lobed, obtuse to rounded	ovate triangular, acute

ciated with sandstone and granitic outcrops as well as other taxa from lowland Guianan forests. Orchids include *Brassia bidens* Lindley, *Catasetum barbatum* (Lindley) Lindley, *Catasetum discolor* (Lindley) Lindley, *Braemia vittata* (Lindley) Jenny, *Chaubardiella tigrina* (Garay & Dunsterville) Garay, *Galeottia jorisiana* (Rolfe) Schlechter, and many others, including not fewer than 10 distinct *Octomeria* species.

Etymology. The name refers to the only locality where this novelty is known, the ascent to Cerro Venamo, along the road from El Dorado to Santa Elena de Uairén, in Bolívar State, Venezuela. The topography is steep and broken on this ascent and so is the road, thus being commonly known as La Escalera, "the stairway."

Pleurothallis stellata I. Ramírez & Carnevali, sp. nov. TYPE: Venezuela. Distrito Federal: tall cloud forest at ca. 4500 ft., above El Limón, Mar. 1961, *G. C. K. Dunsterville 610* (holotype, AMES). Figure 8.

Pleurothallis haec *P. indice* affinis sed foliis proportione angustioribus auriculis minoribus, spathis non obovatis nec suberectis, synsepalo quam sepalo postico angustiore, sepalis petalisque proportione latioribus, labello subtrilobato obtuso discrepat.

Epiphytic, cespitose *herbs*; *rhizome* abbreviated; *stems* erect, terete, 10–12 cm long, bearing 2 thin, close-fitting sheaths below the middle; *leaves* 7–9 cm long, 2.0–2.5 cm wide, narrowly ovate to lanceolate, acute, thin but fairly rigid; *inflorescences* of a single flower borne in succession from a gray-brown, horizontal, ca. 2 cm long sheath at base of leaf; pedicels ca. 10 mm long, ovary ca. 3 mm long; *flowers* subfleshy, resupinate, widely spreading (thus flower stellate), relatively showy for the section, sepals and petals deep, rich, very beautiful "wine-purple" (fide type), with veins of sepals (particularly dorsal sepal) showing up in even darker color, all inner surfaces covered with microscopic short glandular projections, rather too short to be called hairs (fide type, ex schedulae); *dorsal sepal* 12 × 6 mm, narrowly ovate, acuminate, acute, 5-nerved; lateral sepals totally connate into a lanceolate synsepal 12 × 5 mm, acute, acuminate, 6-nerved; *petals* 8.4–8.6 × 1.7–1.9 mm, narrowly elliptic, acuminate, thick and fleshy at base, margins finely ciliate, 1-nerved; *labellum* 1.9–2 mm long, 1.9–2 mm wide when spread, fleshy, dark wine purple, surface finely glandular, ovate-triangular, somewhat 3-lobed, obtuse to rounded, with a transverse ridge at base, flexibly attached to column, glenion well-developed; *column* 1.4–1.6 mm long, stout, oblongoid, dorsoventrally depressed, puce-colored, stigmatic surfaces two, elliptic, shiny; rostellum acicular; anther creamy white; pollinia 2, hard, yellow.

Etymology. The name refers to the stellate aspect of the flower, which is due to the relatively similar shapes of the widely spreading dorsal sepal, synsepal, and petals.

This showy new species is superficially reminiscent of the Colombian species *Pleurothallis index* Luer. However, *Pleurothallis stellata* differs from *P. index* in a number of features, especially the lack of the suberect spathe. In addition, the large, overlapping basal lobes found in the leaves of *P. index* are much reduced and non-overlapping in the Venezuelan *P. stellata.* Moreover, the generally smaller, differently proportioned flowers of *P. stellata* are distinct. In particular, the labella of the two taxa are very different. See Table 1 for a comparison of the two species.

Acknowledgments. The authors are grateful to Carl A. Luer, Bruno Manara, Rossana Marrufo, and Carlos Yam for the line drawings, to the curators of

the herbaria cited herein for their assistance, and to Gustavo A. Romero for informative discussions and for his editorial help.

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A New Species of *Cipura* (Iridaceae) from Colombia and Venezuela

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ABSTRACT. *Cipura gigas* is a new species of this Neotropical genus of nine species that extend from Paraguay in the south to Cuba and Mexico in the north. Apparently most closely related to the widespread *C. paludasa*, *C. gigas* is distinguished by its height (50–100 cm), the large bulb (ca. 3 cm diam.) with resinous tunics, basal leaves that are mostly 8–10 mm wide, lilac-purple flowers, and the inner tepals that form a narrow-mouthed urn-like cup 10–13 mm long. The species is restricted to the Orinoco basin of eastern Colombia and adjacent Venezuela. We provide a revised key to the genus.

Key words: *Cipura*, Colombia, Iridaceae, Iridoideae, Venezuela.

Cipura Aublet (Iridaceae, Iridoideae) is a New World genus in the tribe Tigridieae that is characterized by a bulbous rootstock, plicate leaves, and an ancestral, basic chromosome number of $x = 7$ (Goldblatt, 1990, 1998). *Cipura* is distinguished by the presence of a subapical cauline leaf inserted at the base of the subterminal inflorescence(s); inner tepals that are held erect, often overlapping and thus forming a wide- to narrow-mouthed cup; and inner tepal limbs that are short or obscurely distinguished from the claws (Goldblatt & Henrich, 1987, 1999). The genus extends from Paraguay and southern Brazil to central Mexico and Cuba, and now includes nine species (Ravenna, 1988).

Two species were unnamed in Goldblatt and Henrich's review (1987) of the genus. One of these, *Cipura* sp. 1, was subsequently described as *C. formosa* by Ravenna (1988). The second species, *Cipura* sp. 2, from the frontier region between Colombia and Venezuela and now known from ample material, is described here as *C. gigas*.

In his review of *Cipura*, Ravenna (1988) also added another new species, *C. paradisiaca* Ravenna from Brazil, evidently closely related to *C. xanthomelas* Martius ex Klatt. Ravenna also presented an argument for the recognition of *C. inornata* Ravenna, a species included by Goldblatt and Henrich (1987) in *C. campanulata* Ravenna. The latter was regarded as a synonym of *C. cubensis* Grisebach by Ravenna (1988). Lastly, Ravenna provided a new name, *C. insularis*, for the Cuban species *C. cubensis* Wright ex Saville, a homonym in *Cipura*, dating from 1871. The latter species, evidently closely related to *C. cubensis*, was described when collected as having yellow flowers. It otherwise closely resembles a slender *C. cubensis*. *Cipura* thus currently has nine species. *Cipura cubensis* and *C. insularis* are difficult to distinguish from *C. inornata* from herbarium material, and we question their status as separate species. According to Ravenna, *C. cubensis* may be separated by the almost flat leaves, bell-shaped perianth, inner tepals nearly as long as the outer, and minutely funnel-shaped stigma versus lightly plicate leaves, cup-shaped perianth, inner tepals shorter than the outer, and minutely 3-lobed stigma in *C. inornata*. Illustrations showing the floral differences are sorely needed.

Previous studies reported three species of *Cipura* from Colombia, *C. paludosa* Aublet, *C. rupicola* Goldblatt & Henrich, and *C. gigas*, described here, before reported as *Cipura* sp. 2 (Goldblatt & Henrich, 1987) or *Cipura* sp. A (Goldblatt & Henrich,

1999). *Cipura rupicola*, however, only occurs in lowland Venezuela adjacent to Colombia.

In this paper we describe *Cipura gigas* as a new species and provide a key to the genus as a provisional contribution anticipating the publication of Ravenna's promised revision of the genus (Ravenna, 1988).

Cipura gigas Celis, Goldblatt & Betancur, sp. nov. TYPE: Colombia. Guaviare: municipio de Miraflores, Serranía La Lindosa, trocha al Nuevo Tolima, finca Casa Blanca, cercanías de la casa, en sabana potrerizada, 2°29′12″N, 72°41′13″W, 465 m, 1 June 1997, *J. Betancur & R. López 7296* (holotype, COL; isotypes, COAH, HUA, K, MO, NY, P, US). Figure 1.

Plantae 50–100 cm altae; bulbo 1.5–3 cm longo, ca. 3 cm diametro, tunicis nigribus resinosis nitidus, foliis basalibus 1–2(–3) ad 78 cm longis (2–)8–10 mm latis ensiformibus plicatis, rhipidiis 2–3 spatho exteriore ad 3 mm longo interiore ad 4.5 cm longo 3–6 florum, floribus purpureis tepalis interne cremei striatis exteriore luteis striatis interne, tepalis exterioribus 17–30 mm longis patentibus interioribus 10–13 mm longis erectis cupulis urciformibus, filamentis ca. 5 mm longis, antheris 3–4 mm longis ad stylum appresis, ovario 1–1.9 cm longo ellipsoideo incluso, capsulis 1.2–2 cm longis in spathis inclusis.

Plants 50–100 cm high. Bulb 1.5–3 cm long, ca. 3 cm diam., subglobose to ellipsoid with shiny, blackish, resinous tunics. Basal leaves 1 or 2(to 3), typically 30–78 cm × (2–)8–10 mm, sword-shaped, with open sheathing base, attenuate, plicate. Flowering stem 1 to 3 per plant, 40–84 cm long, erect, ± terete. Inflorescences with 2 or 3 pseudolateral rhipidia, on peduncles ca. 6 mm long, subtended by a subapical, attenuate cauline leaf 13–25 cm × 6–10 mm; spathes green, leafy, the outer 2.5–3 cm long, the inner 3.5–4.5 cm long; floral bracts 2.2–3 cm long. Flowers 3 to 6, lilac, borne on pedicels 10–17 mm long, the inner tepals with a central cream stripe outside and yellow central streak inside with darker lilac spots toward the margins and purplish toward the base, tepals unequal, connate at the base for ca. 2 mm, the outer 17–30 mm long, spreading, spathulate, obtuse, the inner 10–13 mm long, imbricate, elliptic, obtuse, forming an urn-like cup. Stamens with free filaments 5 mm long, pale lilac; anthers 3–4 mm long, appressed to the style, reaching to just below the base of the style branches. Ovary 1–1.9 cm long, ellipsoid, green, included in the spathes; style 8 mm long, dividing into three long branches, 3 mm long, each with an abaxial glandular stigmatic lobe and a pair of short, erect, crest-like adaxial appendages. Capsules 1.2–2 cm long, enclosed in the spathes, ellipsoid; seeds ca. 50 per capsule, ellipsoid, 1.4–1.5 × 1–1.1 mm, rugose, brown-black.

Etymology. The epithet refers to *Cipura gigas* being the tallest member of the genus, 50–100 cm high, with the broadest leaves, up to 10 mm wide, and the largest bulbs, up to 3 cm in diameter.

Distribution and habitat. *Cipura gigas* occurs in eastern Colombia and adjacent northwestern Venezuela, at 75–465 m, in open savannas on isolated hills in the Guayana region, such as El Tuparro National Park, La Lindosa (Colombia), and Atures (Venezuela).

The presence of *Cipura gigas* in Colombia was first noted by Goldblatt and Henrich (1987, 1999), but they did not describe the species due to insufficient material. We consider *C. paludosa* and *C. gigas* to be closely allied, because both species have inner tepals forming a narrow-mouthed urn, but they are easily distinguished by the size of the plant (10–40 vs. 50–100 cm tall), the bulb size (0.8–2 vs. ca. 3 cm diam.), the width of the basal leaves (1.5–5(–7) vs. (2–4)8–10 mm), and the length of the flowering stems (4.5–20 vs. 40–84 cm). Also, *C. paludosa* has non-resinous bulb tunics, whereas those of *C. gigas* are strongly resinous and shiny.

Paratypes. COLOMBIA. **Casanare:** márgen derecha del Río Casanare, Caserío Indígena Tsamani, 31 jul. 1977, *Niño 317* (COL). **Meta:** La Macarena, camino del Río Guayabero a Caño Cristales, 26 jun. 1996, *Cárdenas 7204* (COAH); Puerto Lleras, Menegua, 15 ene. 1937, *García-Barriga 9009* (COL); Puerto Gaitán, Centro de Investigaciones Carimagua, jul. 1994, *G.C. 60* (VALLE); La Macarena, Vereda Cachivera, por el camino que conduce del Río Guayabero a Caño Cristales, 1 ago. 2000, *López 6765* (COAH); Puerto López, finca Los Laureles, 3 jun. 1980, *Rangel 1429* (COL); Laguna de Carimagua, 1 nov. 1975, *Rewinkel 20* (COL); Puerto Gaitán, Carimagua, 150 m, 11 jun. 1905, *Rippstein 3055* (VALLE); Puerto Lleras, Rancho Menegua, 100 km SE de Villavicencio, 16 jul. 1945, *Schiefer 814* (GH). **Vichada:** Caño Urimica, 5 ene. 1972, *Cabrera 2055* (COL); Río Vichada, 13 jul. 1945, *di Giovanni 146* (COL); Cumaribo, alrededores del Centro Administrativo, Territorio Faunístico El Tuparro, entre los valles inferiores de los ríos Tuparro y Tomo, 11 ago. 1979, *Salamanca 432* (COL); Cumaribo, Territorio Faunístico El Tuparro, 1.5 km N de la carretera a El Tapón, 11 sep. 1979, *Vincelli 1230* (COL, FMB, MO). VENEZUELA. **Amazonas:** Atures, región de Rincones de Cachorro, a 30 km N de Puerto Ayacucho y a unos 5 km NE de Galipero, 23 sep. 1980, *Huber 5711* (MO); Atures, by tree on E side of road 5.5 km S of Puerto Ayacucho, 2.4 km S of Alcabala, 8 Sep. 1985, *Steyermark 131598* (MO); **Portuguesa:** Guanare, terrenos de la UNELLEZ, mesa de cavacas, 4 Oct. 1998, *Aymard 7081* (MO).

KEY TO THE SPECIES OF *CIPURA*

1a. Flowers yellow; capsules globose and exserted from the spathes.

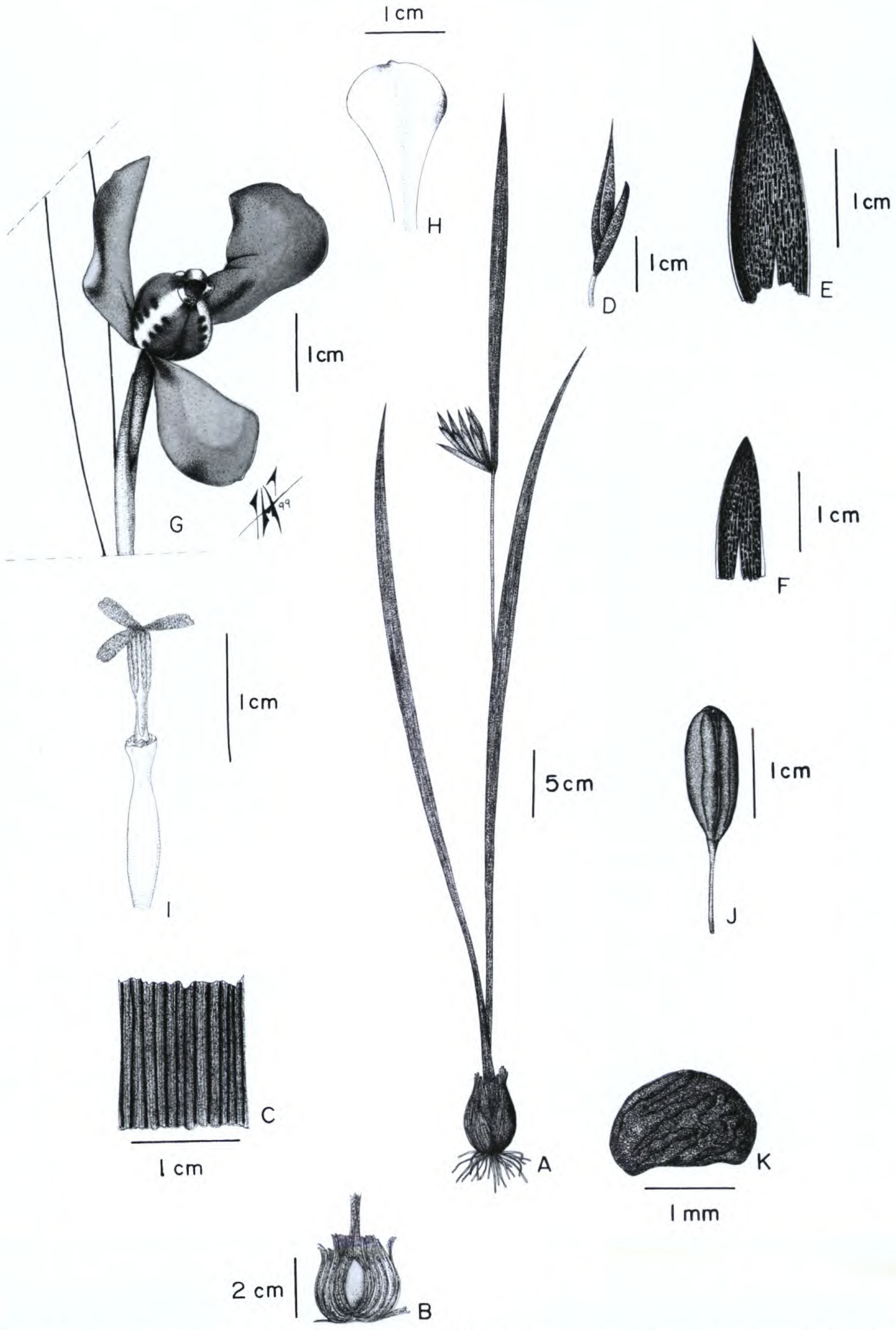

Figure 1. *Cipura gigas* Celis, Goldblatt & Betancur. —A. Habit. —B. Longitudinal section of bulb. —C. Detail of a basal leaf. —D. Floral unit. —E. First floral bract. —F. Second floral bract. —G. Flower. —H. Outer tepal. —I. Gynoecium and androecium. —J. Capsule. —K. Seed. (Drawn from the holotype, *Betancur & López 7296*, COL.)

2a. Inner tepals yellow with black markings on the keel and at the apex, less than half as long as the outer tepals, to 14 mm long . . . . . *C. xanthomelas*

2b. Inner tepals entirely pale yellow, somewhat more than half as long as the outer, to 18 mm long.

3a. Style branches terminating in paired crests . . . . . *C. paradisiaca*

3b. Style branches truncate, without obvious crests . . . . . *C. rupicola*

1b. Flowers shades of blue to violet or pale creamy yellow; capsules cylindric-fusiform or nearly globose, included in the spathes.

4a. Rhipidia solitary or two, subtended by a cauline leaf shorter than or about as long as the spathes . . . . . *C. formosa*

4b. Rhipidia usually at least two, subtended by a cauline leaf usually at least twice as long as the spathe.

5a. Bulbs 15–20 mm diam., with tunics not, or only slightly, resinous.

6a. Flowers usually pale blue to violet, rarely white; inner tepals with a yellow nectar guide and a zone of nectariferous tissue, often outlined in violet; flowers (1)2 to 3 in each rhipidium; inner tepals closely imbricate forming an urn-shaped cup, about half as long as the outer . . . . . *C. paludosa*

6b. Flowers white to cream to pale yellow, rarely pale blue; inner tepals without yellow nectar guides or a zone of nectariferous tissue; flowers solitary in each rhipidium; inner tepals somewhat shorter to about as long as the outer and not closely imbricate (distinctions below from Ravenna, 1988).

7a. Inner tepals distinctly shorter than the outer, forming a wide cup; leaves shallowly pleated . . . . . *C. inornata*

7b. Inner tepals nearly as long as the outer and forming a bell; leaves ± flat.

8a. Perianth white to cream . . . . . *C. cubensis*

8b. Perianth pale yellow . . . . . *C. insularis*

5b. Bulbs about 30 mm diam., with heavily resinous, shiny tunics . . . . . *C. gigas*

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Nomenclatural Changes in *Epipactis* (Orchidaceae) from China

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Abstract. New rank is proposed for *Epipactis humilior* (Tang & Wang) S. C. Chen & G. Zhu and *E. helleborine* (L.) Crantz var. *tangutica* (Schlechter) S. C. Chen & G. Zhu. *Epipactis humilior* was formerly treated as a variety of *E. mairei* Schlechter, but distinctly differs from the latter by having a slender, creeping, elongated rhizome, ovate-lanceolate or lanceolate leaves 2–3 cm wide and scarcely or slightly scabrous adaxially. *Epipactis helleborine* var. *tangutica* is characterized by possessing on the epichile two much larger fleshy calli rather than small semiorbicular warty lamellae seen in *E. helleborine*.

Key words: China, *Epipactis*, Orchidaceae.

Epipactis Zinn is an orchid genus of some 20 species distributed mainly in Europe and eastern Asia with a few species extending to North America, Indochina, and Thailand. In China eight species and one variety were recognized recently (Luo, 1999), of which some nomenclatural problems have been discussed (Chen & Luo, 2002a, 2002b) after a recent visit of the senior author to European herbaria. This is another note, proposing new ranks for two taxa: *Epipactis humilior* and *E. helleborine* var. *tangutica*.

Epipactis humilior (Tang & Wang) S. C. Chen & G. Zhu, stat. nov. Basionym: *Epipactis mairei* Schlechter var. *humilior* Tang & Wang, Acta Phytotax. Sin. 1: 67. 1951. TYPE: China. Sikang [Sichuan]: without precise locality, *S. M. Liu 1107* (holotype, PE).

This is a rare taxon that was earlier treated as a variety of *Epipactis mairei* in volume 17 of the *Flora Reipublicae Popularis Sinicae* (1999). *Epipactis humilior* is similar in floral structure to *E. mairei*, but its flowers are slightly smaller, with lateral sepals 13–17 mm long (vs. 15–20 mm long in *E. mairei*). Further, *Epipactis mairei* is a widespread species characterized by having a rather thick and short rhizome and usually elliptic to elliptic-ovate leaves up to 3–8 cm wide and strongly scabrous adaxially. *Epipactis humilior* is quite distinctive by possessing a slender, creeping, elongated rhizome and ovate-lanceolate to lanceolate leaves 2–3 cm wide and scarcely or slightly scabrous adaxially. These features are of significance in the interspecific classification of *Epipactis* (Chen & Luo, 2002a). For example, *E. helleborine*, *E. papillosa* Franchet & Savatier, and *E. mairei* are never found possessing slender creeping rhizomes, while *E. royleana* Lindley, *E. gigantea* Douglas ex Hooker, and *E. veratrifolia* Boissier & Hohenacker always have slender, creeping, elongated rhizomes.

The vegetative characters of *Epipactis humilior* are similar to those of *E. veratrifolia* Boissier & Hohenacker (syn. *E. comsimilis* Wallich ex Hooker f., 1890, non D. Don, 1825, see Chen & Luo, 2000b), but the floral structure is quite different. The hypochile of the lip in *E. veratrifolia* is broadly grooved, without side lobes, conspicuously narrower than the epichile, and lacking lamellae adaxially, whereas in *E. humilior* it has erect side lobes, conspicuously broader than the epichile, and with 3 crisped lamellae on the disk. It therefore seems more reasonable to treat it as a separate species than a variety.

Epipactis helleborine (L.) Crantz var. **tangutica** (Schlechter) S. C. Chen & G. Zhu, stat. nov. Basionym: *Epipactis tangutica* Schlechter, Feddes Repert. Spec. Nov. Regni Veg. Beih. 4: 149. 1919. TYPE: China. Kansu [Gansu]: Tangut, *N. M. Przewalski s.n.* (syntypes, B [presumed destroyed], K, LE not seen, P).

Epipactis tangutica was reduced to a synonym of *E. helleborine* in *FRPS* vol. 17 (Luo, 1999), though it was recognized by Tang and Wang as a distinct species in their manuscript (unpublished, preparing for the orchid flora of China). A close examination of the type specimens at K and P revealed

that *E. tangutica* is distinguishable by its epichile on which two basal appendages are large fleshy calli rather than two smaller semiorbicular warty lamellae as seen in *E. helleborine*. Considering that the appendages on the epichile of the floral lip are usually variable in some species of this genus, and phytogeographically this entity is sympatric with *E. helleborine*, it seems reasonable to suggest that *E. tangutica* be recognized at the varietal rank within *E. helleborine*.

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A New Species of *Monardella* (Lamiaceae) from Baja California, Mexico, and Southern California, United States

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ABSTRACT. *Monardella stoneana* (Lamiaceae), a narrow endemic from northern Baja California, Mexico, and southern San Diego County, California, is described and illustrated. Differences in leaf and bract morphology, pubescence, stem glands, and habitat separate it from *M. linoides* A. Gray and *M. odoratissima* Bentham, apparently its closest relatives. The reinstatement of *M. viminea* Greene at the specific rank is supported on the basis of distinctive morphology and biological isolation. A key is included to separate *M. stoneana* from all of the perennial *Monardella* species known to occur in San Diego County, California.

Key words: Lamiaceae, *Monardella*, Peninsular Range, rare plants, taxonomy.

The genus *Monardella* Bentham consists of approximately 30 species of annual and perennial herbs found in western North America with a center of distribution in California where almost all *Monardella* taxa are found. The flowers in this genus are remarkably similar, with many species having flowers that are virtually indistinguishable. The most notable exceptions are *M. macrantha* A. Gray and *M. nana* A. Gray, which are unique in that they have relatively longer flowers that appear to have evolved in response to long-tongued pollinators (Elvin & Sanders, pers. obs.).

Monardella species vary mostly in their vegetative characters, notably leaf size and shape, pubescence, and bract morphology. Therefore, adaptation to different pollinators does not appear to have been a major factor leading to speciation in this group. Instead, it appears to have been driven by a combination of isolation and vegetative and/or physiological adaptation to local conditions. This evolutionary pattern is not unique within the California Floristic Province. For example, *Ceanothus* L. (Rhamnaceae), *Arctostaphylos* Adanson (Ericaceae), and *Sibara* Greene (Brassicaceae) are all genera where the taxa differ mostly in vegetative characters with little to no variation in floral morphology (see treatments in Hickman, 1993).

The perennial *Monardella* populations in southern California are confusingly similar but fall into natural groups based on a series of shared characters and generally non-overlapping ranges. The most difficult groups of species, and taxa that have regularly been confused in the field and herbaria, are in the subgenus *Monardella* sect. *Monardella* (*Pycnanthae* (Briquet, 1896) sect. *Odoratissimae* (Epling, 1925), but see Allen, 1994), which includes the *M. odoratissima* Bentham and *M. linoides* A. Gray species groups. The taxa in these groups can be recognized by small but consistent differences between them (Abrams, 1912; Epling, 1925; Jepson, 1943) and have generally been recognized as distinct (Greene, 1902; Epling, 1925; Jokerst, 1993). With experience one can tell the general locale from which a particular plant came by the examination of a combination of pubescence, gland, leaf, and bract characters.

Plants in the *Monardella odoratissima* group have wide leaves (lance-ovate) and glabrous to sparsely pubescent herbage. Their leaves have a distinct petiole, an acute base, and a relatively broad blade that expands quickly to the widest point. The stems and leaves are generally either glabrous or sparsely pubescent to sparsely short villous. *Monardella odoratissima* is absent from southern California (Jepson, 1925; Munz, 1974; Beauchamp, 1986; Jokerst, 1993) except for the derivative taxon *M. australis* Abrams. We now add the San Ysidro Mountains species described below as a new member of the *M. odoratissima* group.

Plants in the *Monardella linoides* group are typically characterized by narrow leaves (broadly linear) and herbage covered with short, dense pubescence. Their leaves have a winged petiole, an

attenuate base, and a consistently relatively narrow blade that expands gradually to the widest point. The stems and leaves have short, dense pubescence in most cases, with mixed long and short, dense hairs in a few populations (e.g., *M. robisonii* Epling). *Monardella linoides*, which is nearly endemic to southern California, is represented by a series of allopatric populations that are separated by clusters of small but consistent characters (Gray, 1876; Greene, 1902; Abrams, 1912; Epling, 1925), which may prove to be distinct taxa. In our view, most of these populations can be readily separated without much ambiguity.

Many taxonomic problems exist in *Monardella*, but we are not commenting on the taxonomic status of all described entities at this time. Our intent in this paper is simply to better define the taxa in a discrete group of geographically and morphologically isolated plants in southern California. We do note that the Mojave Desert populations of *Monardella linoides* do not fit comfortably within *M. linoides* subsp. *linoides*, contrary to most recent floristic works (Munz, 1974; Jokerst, 1993). They have different morphologies, notably pubescence length and density, and are geographically isolated from *M. linoides* subsp. *linoides* of the Peninsular Range. The taxonomic status of these northern populations is a separate issue and will be the subject of future work. This paper describes one species that has been confused with another simply because they are parapatric and similar in appearance.

We have noticed that the perennial species of *Monardella* in southern California grow in sites that are relatively moist during the summer. They are commonly restricted to canyon bottoms, north-facing slopes, or other sites where water accumulates during the rainy season. However, they do not occur in permanently wet or saturated soils. This restriction to specialized and highly limited "micro-habitats" has resulted in patchy distributions and genetic isolation, providing opportunities for speciation. The product of one such apparent isolation event is described below.

Monardella stoneana Elvin & A. C. Sanders, sp. nov. TYPE: U.S.A. California: San Diego Co., "Monardella Gulch" on W side of Tecate Peak, E of Marron Valley, growing in cracks of bedrock and between large stones in the bottom of an intermittent stream, 22 July 2000, *Mark A. Elvin & Cindy Burrascano 1460* (holotype, RSA; isotypes, NY, SD, UC, UCR). Figures 1–3.

Herba perennis, odoratissima; plantae subglabrae ad puberulas pilis curtis et simplicibus et uni- aut bicellularibus; obscure et sparsim glandulosae; folia et caules virides sed saepe purpurascentes prope apices; folia lance-ovata longitudine 15–30 mm et latitudine 4–10 mm; petioli distinguibiles; bracteae extimae plerumque bijugatae, mediae trijugatae et chartaceae, intimae aciculares; bractae longitudine 7–10 mm et latitudine 2.5–4 mm; semina brunnea ad nigra, ovata, longitudine 2.0–2.75 mm.

Suffruticose perennial, very odorous; low, compact, and non-rhizomatous; subglabrous to minutely pubescent with short, simple 1- or 2-celled hairs; obscurely and sparsely glandular (less than 50 glands/cm on one side of stem below the third leaf node from the apical glomerule); stems several to many, suffruticose, ascending to a height of 20–50 cm, rarely to 60 cm. Leaves lanceolate to lance-ovate, 15–30 × 4–10 mm (leaf length to width ratio 3–5:1), green but often purple-tinted near the stem apex, with distinct petioles 2–4 mm long, base acute, subglabrous to sparsely puberulent above and sparsely puberulent below (especially on the veins). Inflorescences glomerate; bracts: outermost ones generally in 2 pairs, middle ones papery and in 3 pairs (7–10 × 2.5–4 mm), lanceolate to narrowly lanceolate-ovate, innermost ones acicular; calyces of ± the same length as the middle bracts, generally with 13 veins. Flowers pale pink, sometimes tinged light blue, with corolla lobes 2.8–3.7 mm long. Seeds brown to black, ovate, 2.0–2.75 mm long.

Etymology. The specific epithet has a dual meaning. It honors our esteemed colleague, Jennifer Stone (1949–2000), who dedicated her life to the understanding and preservation of our special and diverse flora in southern California. It also refers to the species' frequent occurrence among the stones of intermittent streams. We propose "Jennifer's monardella" as the common name for this species.

Distribution and ecology. *Monardella stoneana* is a narrow endemic presently known from only six occurrences, five in the San Ysidro Mountains of San Diego County, California, U.S.A., and immediately adjacent Baja California, Mexico, and an outlying occurrence about 50 km to the south at Arroyo Jatay, about 75 km north of Ensenada. The California localities include the west side of Tecate Peak ("Monardella Gulch"), two unnamed canyons on the northwest side of Otay Mountain, and two canyons on the south side of Otay Mountain: "Copper Canyon" and "Wild Bill's Draw" (Fig. 2). This last canyon drains into Baja California and contains *Monardella* populations on both sides of the international boundary. It is possible that *M. stoneana* occurs in additional coastal arroyos and foothill

Figure 1. *Monardella stoneana* Elvin & A. C. Sanders. —A. Habit. —B. Inflorescence. —C. Flower. —D. Bracts. —E. Leaves and stem. Scale bars 1 cm, to the right of associated figures (B and D share a scale bar).

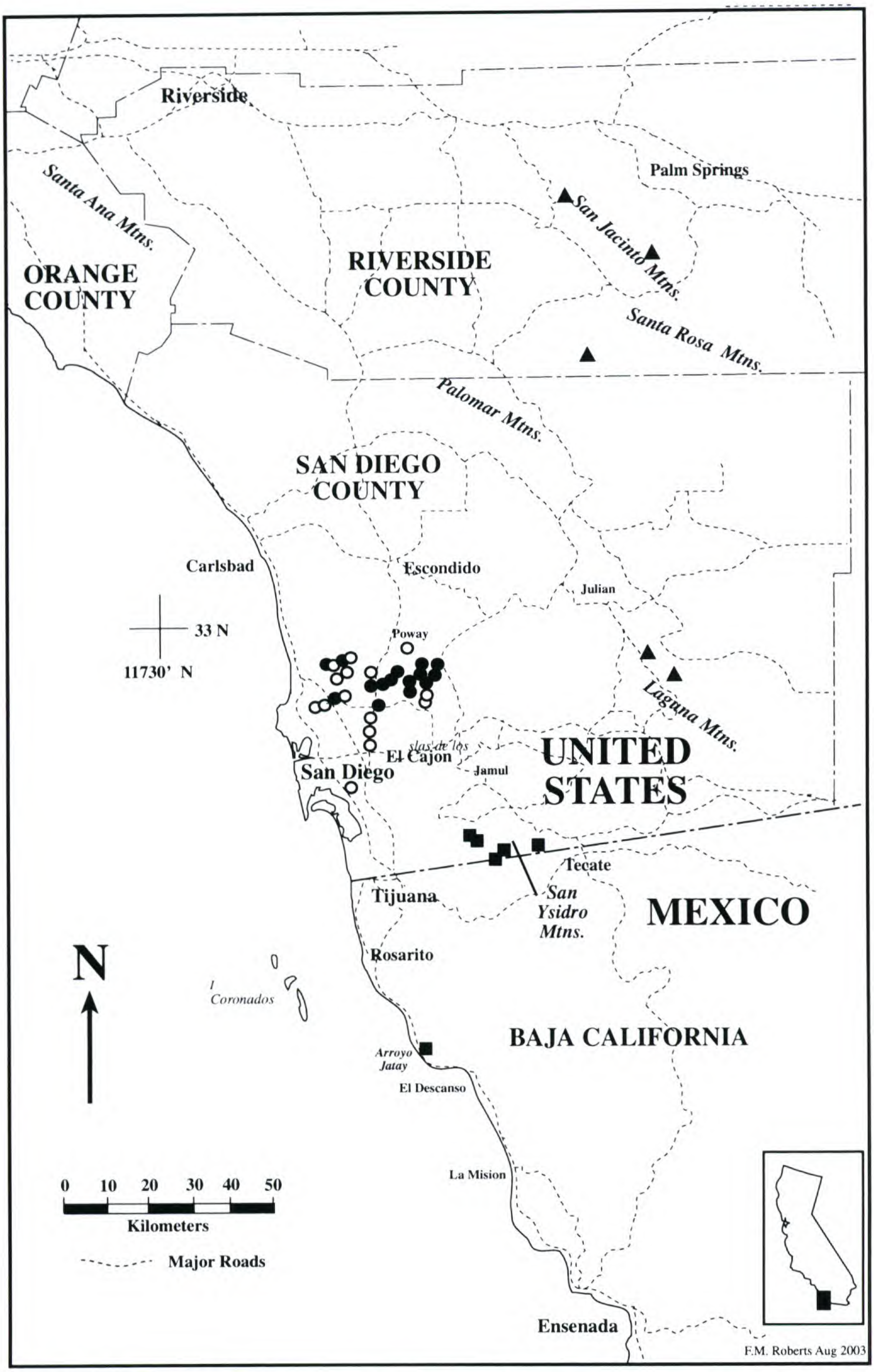

Figure 2. Distributions of *Monardella stoneana*, *M. viminea*, and *M. linoides* subsp. *linoides*. (Note: This figure depicts a representation of the approximate distributions of these taxa and is not intended to represent precise location data from herbarium specimens.) Circles—*Monardella viminea*: open—extirpated occurrences, closed—extant occurrences (as of August 2003); squares—*Monardella stoneana*; triangles—representative *Monardella linoides* subsp. *linoides* locations.

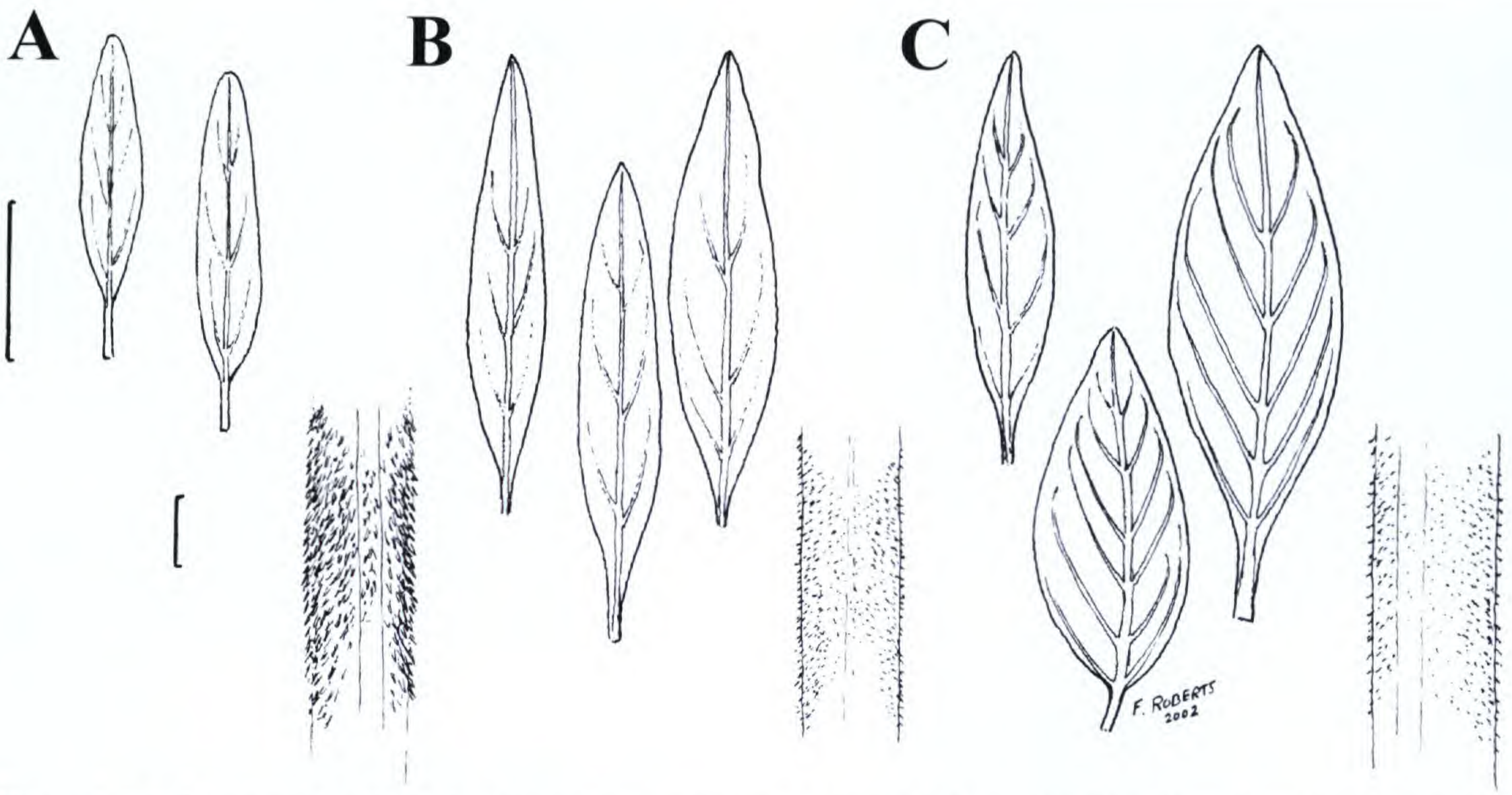

Figure 3. Pubescence details of the leaves (top) and stems (bottom) of *Monardella linoides* subsp. *linoides* (A), *M. viminea* (B), and *M. stoneana* (C). Leaf scale bar (top) = 1 cm, stem scale bar (bottom) = 1 mm.

canyons between the San Ysidro Mountains and Arroyo Jatay and possibly in similar habitats farther south. All known occupied sites are in intermittent streams that carry water for several weeks to months during and after the winter rainy season. The Arroyo Jatay site even supports fish and crayfish in permanent pools. *Monardella stoneana* most often grows among boulders, stones, and in cracks of the bedrock of intermittent streams in rocky gorges surrounded by coastal sage scrub and chaparral. It is found between 10 and 660 m elevation, with all known U.S. occurrences above 175 m.

Associated species in riparian habitat include *Baccharis salicifolia* (Ruiz & Pavón) Persoon, *Bothriochloa barbinodis* (Lagasca y Segura) Herter, *Brodiaea orcuttii* (Greene) Baker, *Cupressus forbesii* Jepson, *Iva hayesiana* A. Gray, *Juncus acutus* L. subsp. *leopoldii* (Parlatore) Snogerup, *Mimulus guttatus* DC., *Muhlenbergia rigens* (Bentham) Hitchcock, and *Stemodia durantifolia* (L.) Swartz.

Monardella stoneana is similar to the *M. odoratissima* species group in leaf size, pubescence, and general appearance. Although it most closely resembles *M. glauca* and *M. odoratissima* subsp. *pallida* (A. A. Heller) Epling from northern California and Oregon, there are a number of differences between *M. stoneana* and taxa in the *M. odoratissima* group (e.g., herbage, bract size, leaf size, scent, habitat). *Monardella stoneana* is also similar to the *M. linoides* species group in leaf size, general appearance, and habit. Even though *M. stoneana* has been mistaken for a species in the *M. linoides* group in the past, there are several differences that separate it from that group.

Paratypes. MEXICO. **Baja California:** in drainage ("Wild Bill's Draw"), S side of Otay Mtn., 12 Aug. 2000, *C. Burrascano, M. Kelly, L. Braund & R. Hutsel s.n.* (SD); Arroyo Jatay, 11 June 1980, *R. Moran 28774* (SD), 27 July 2001, *A. C. Sanders & M. A. Elvin 24488, 24514, 24517* (UCR). U.S.A. **California:** in dry streambed & mixed chaparral on Tecate Peak, 20 June 1979, *F. Sproul s.n.* (SD); Otay Mtn., mesic canyon S of Otay Lake, 19 June 1987, *C. Reiser s.n.* (SD); San Ysidro Mtns., NW foothills just SE of Otay Lake, 2.0 km ENE of Savage Dam along unnamed canyon above Buschalaugh Cove, 20 June 2001, *F. Roberts 5500* (UCR); Marron Valley, tributary to Cottonwood Creek, "Monardella Gulch," W slope of Tecate Peak, 4 Aug. 2000, *A. C. Sanders & M. A. Elvin 23593* (UCR).

Relationships of *Monardella stoneana*

Monardella stoneana belongs in subgenus *Monardella* sect. *Monardella* and within that is most closely related to the *M. odoratissima* group (including *M. glauca* Greene) and less closely to the *M. linoides* group, specifically *M. linoides* subsp. *viminea* (Greene) Abrams. *Monardella stoneana* differs from the species in each of these groups in a number of characters (e.g., leaf and bract morphology, pubescence, stem glands, habitat). It has commonly been confused with *M. linoides* subsp. *viminea*, apparently simply because that is the only similar *Monardella* that has been recognized as present at low elevations in San Diego County, California, until now.

The *Monardella odoratissima* Group

The herbage of *Monardella stoneana* is less puberulent and less glandular than *M. odoratissima*, which is minutely but conspicuously puberulent, and sparsely to moderately glandular. *Monardella stoneana* inflorescence bracts, those subtending the head, are smaller and greener than those of *M. odoratissima*, which are relatively large (8–17 × 4–10 mm), longer than the subtended calyces, and white or purple-tinged. The leaves of *M. stoneana* are shorter and narrower (length to width ratio of 3–5:1) than those of *M. odoratissima* (length to width ratio of 2–3:1). *Monardella stoneana* leaves are lanceolate to lance-ovate, while *M. odoratissima* has lance-ovate to ovate leaves (5–16 mm wide). *Monardella stoneana* has a pungently minty scent, while *M. odoratissima* has a sweeter scent more typical of *Monardella*.

Monardella stoneana grows in more perennially mesic environments than those of *M. odoratissima* (including *M. glauca* and *M. odoratissima* subsp. *pallida*), which grows on dry slopes and flats, which are often open and sandy or gravelly. *Monardella odoratissima* occurs at higher elevations in montane forests of the Sierra Nevada Mountains (Jepson, 1943; Munz, 1959; Botti, 2001) that are at least 300 km to the north beyond the Transverse Range and Mojave Desert. This separation by a mountain range and a desert acts as a strong geographic isolating mechanism. Habitats in the San Bernardino and San Jacinto Mountains of southern California that are similar to those occupied by *M. odoratissima* in the Sierra Nevada Mountains contain the *M. odoratissima* segregate species *M. australis* (Jokerst, 1993).

The *Monardella linoides* Group

Monardella stoneana is distinct from the *M. linoides* group, specifically *M. linoides* subsp. *viminea*. *Monardella stoneana* grows in an environment that is wet for a much longer period of time than *M. linoides* subsp. *viminea*. The herbage of *M. stoneana* is less hairy than that of *M. linoides* (including that of *M. linoides* subsp. *viminea*). The stems and leaves of *M. stoneana* are sparsely glandular, while those of *M. linoides* subsp. *viminea* are conspicuously and rather densely glandular with greater than 100 glands/cm on one side of stem below the third leaf node from the apical glomerule. *Monardella stoneana* leaves are broader and have a more distinct base and petiole than *M. linoides* subsp. *viminea*, which has broadly linear to narrowly lanceolate leaves (2–4 mm wide) with attenuate bases (Fig. 3). The bracts of *M. stoneana* are roughly equal to the calyces (middle bracts 7–10 mm long), while the bracts of *M. linoides* subsp. *viminea* are longer than the calyces (middle bracts 10–15 mm long). The relatively large leaves and small bracts of *M. stoneana* readily distinguish it from *M. linoides*, which has relatively small leaves and large bracts.

Species Recognition for *Monardella viminea*

Monardella viminea Greene, Pittonia 5: 85. 1902. *Madronella viminea* (Greene) Greene, Leafl. Bot. Observ. Crit.1: 169. 1906. *Monardella linoides* A. Gray var. *viminea* (Greene) Munz, Manual Southern California Botany, 450. 1935. *Monardella linoides* A. Gray subsp. *viminea* (Greene) Abrams, Ill. Fl. Pacific States 3: 655. 1951. TYPE: U.S.A. California: San Diego Co., locality not given, 1880, *Vasey 491* (holotype, US).

Monardella viminea was originally described by Edward Greene (1902). It was subsequently reduced to varietal rank by P. A. Munz (1935), then shifted to subspecies rank by Leroy Abrams (1951), who has been followed by subsequent authors (e.g., Munz, 1974; Jokerst, 1993). While *M. viminea* and *M. linoides* subsp. *linoides* are undoubtedly closely related, these two taxa are reproductively isolated from each other based on specimen collections between 1862 and 2003 (see selected specimens). *Monardella viminea* flowers from June until August; while *M. linoides* subsp. *linoides* does not flower until September, though some plants occasionally begin flowering in July on the lower desert slopes. The two species occur in radically different environments. *Monardella viminea* is endemic to coastal sage scrub and grows on secondary alluvial benches in ephemeral washes (drainages with running surface water for 24–48 hours after a rain) that cut through cismontane marine and alluvial terraces of the Miramar area within 20 km of the Pacific Ocean. *Monardella linoides* subsp. *linoides* predominantly occurs in transmontane, semi-desert woodlands dominated by pinyons (*Pinus*) and junipers (*Juniperus*). These two *Monardella* taxa are geographically well separated by the Peninsular Range in southern California and adjacent northern Baja California, Mexico. The closest populations are separated by about 50 km in distance and at least 900 m in elevation (Fig. 2). Because of the ecological, seasonal (flowering time), and geographical isolating mechanisms in the wild, there appears to be no opportunity for them to interbreed. No putative hybrids are known to have been collected. We have had both taxa in cultivation under identical con-

ditions at the University of California, Irvine Arboretum, for about two years and noted that they behave differently with respect to flowering. *Monardella viminea* flowers readily, and the flowering period for an individual may last up to 10 to 12 weeks. *Monardella linoides* subsp. *linoides* flowers hesitantly, and the flowering period for an individual lasts only three to four weeks at best. In cultivation the blooming period of *M. viminea* completely overlaps that of *M. linoides* subsp. *linoides*.

These two taxa are also separable on foliage scent, pubescence type, stem glands, and leaf size. *Monardella viminea* has a strong sweet scent, while *M. linoides* subsp. *linoides* has only a very faint scent, often virtually absent. The pubescence of *M. viminea* is relatively sparse, while that of *M. linoides* subsp. *linoides* is short and very dense and obscures the epidermis. Possibly due to this pubescence difference, the glands on the stem of *M. viminea* are conspicuous, but those of *M. linoides* subsp. *linoides* are difficult to detect. The leaves of *M. viminea* are about 15–40 mm long while those of *M. linoides* subsp. *linoides* are about 10–20 mm long (Fig. 3).

Selected specimens. *Monardella australis.* U.S.A. **California:** 10 July 1994, *Sanders & MacKay 14992* (UCR), 26 Sep. 1992, *Dick Swinney 1932* (UCR), 7 Aug. 1968, *Louis C. Wheeler s.n.* (UCR).

Monardella glauca. U.S.A. **California:** 28 Aug. 1935, *B. Bolt 422* (RSA), 10 July 1975, *F. C. Vasek 750710-29* (UCR), 20 Aug. 1965, *C. B. Hardham 13009* (RSA), 13 June 1940, *A. Eastwood & J. T. Howell 8175* (POM), 12 Aug. 1965, *G. Muth 209* (RSA).

Monardella linoides subsp. *linoides.* U.S.A. **California:** 7 June 1963, *R. H. Whittaker & W. Niering 280* (IRVC), Oct. 1875, *Cleveland 6861* (SD), 14 June 1997, *R. E. Riefner 97-188* (RSA), 5 Sep. 1927, *I. L. Wiggins 2860* (RSA), 3 Aug. 1935, *G. F. Harbison 12106* (SD).

Monardella odoratissima subsp. *pallida.* U.S.A. **California:** 6 Aug. 1927, *F. W. Peirson 7659* (RSA), 1 Sep. 1929, *C. B. Wolf 3782* (RSA), 6 Aug. 1967, *J. Hendrickson 2516* (RSA), 20 July 1917, *A. L. Grant 1125* (POM).

Monardella viminea. U.S.A. **California:** 1 Aug. 1982, *J. Dice & L. Allen s.n.* (SD), 3 Aug. 1982, *C. Patterson 1154* (SD); 12 May 1894, *T. S. Brandegee s.n.* (POM), 8 July 1934, *Carl Epling 6253* (RSA).

Conservation Notes

Recognition of *Monardella viminea* at the species rank is significant because the known range of this rare taxon is now restricted to the Miramar Mesa region of San Diego County, California. It is a narrow endemic that remains in only three major watersheds in the Miramar area: (1) Sycamore and West Sycamore Canyons, Murphy and Elanus Canyons, and Spring Canyon; (2) San Clemente Canyon; and (3) Lopez Canyon (see Fig. 2). *Monardella viminea* historically occurred in Beeler, Carroll, and Switzer Canyons (near Poway, Miramar, and San Diego, respectively). *Monardella stoneana* is also a narrow endemic that is only known in the United States from five canyons in two watersheds and Mexico in one canyon (Fig. 2).

Key to the Perennial *Monardella* Species in Subgenera *Monardella* and *Macranthae* Known to Occur in San Diego County, California

1a. Calyces greater than 12 mm, lobes ⅕–½ length of tube; plants generally low and spreading; stems decumbent; plants rhizomatous; leaves usually ± ovate, often strongly so (*Monardella* subg. *Macranthae*).
  2a. Corollas scarlet to red-orange, corolla tube width at opening > 3.1 mm; corolla tube funnelform; pollen white; tube 35–45 mm long; calyx greater than 15 mm long . . . . . *M. macrantha* A. Gray
  2b. Corollas pale white or pastel yellow or pastel pink; corolla tube width at opening < 3.1 mm; corolla tube cylindrical; pollen pink to lavender; tube 20–30 mm long; calyx less than 15 mm long . . . . . *M. nana* A. Gray
1b. Calyces less than 12 mm, lobes ± equal length of tube; plants generally subshrubs; stems generally ascending to erect; plants not or only weakly rhizomatous; leaves narrowly lanceolate to ovate (*Monardella* subg. *Monardella*).
3a. Leaves distinctly bicolored, green above and paler beneath . . . . . *M. hypoleuca* A. Gray
3b. Leaves concolorous, similar on both surfaces.
  4a. Pubescence very dense, stems and leaves whitish with epidermis obscured; foliage very faintly scented; glands inconspicuous; dry interior, montane slopes . . . . . *M. linoides* A. Gray subsp. *linoides*
  4b. Pubescence sparse, stems and leaves green with epidermis visible; foliage strongly scented; glands conspicuous; ephemeral drainages (moist or seasonally wet environments) in coastal foothills and mesas.
    5a. Leaves broadly linear to narrowly lanceolate with attenuate bases, 2–4 mm wide, length to width ratio 7–10:1; leaf glands dense below; stem glands greater than 100/cm on one side below the third leaf node from the apical glomerule; middle bracts 10–15 mm long (longer than calyces); seeds less than 1.9 mm long; plants in ephemeral washes (water only running directly after rain) on secondary alluvial benches . . . . . *M. viminea* Greene
    5b. Leaves lanceolate to lance-ovate with acute bases, 4–10 mm wide, length to width ratio about 3–5:1; leaf glands sparse below; stem glands less than 50/cm on one side below the third leaf node from the apical glomerule; middle bracts 7–

10 mm long (roughly equal to calyces); seeds greater than 1.9 mm long; plants in streambeds and banks of intermittent streams (water running longer than directly after rain) . . . . . .
. . *M. stoneana* Elvin & A. C. Sanders

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Three New Species of *Cordia* (Boraginaceae) from the Guianas

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ABSTRACT. Three new species of *Cordia* (Boraginaceae) are described from the Guianas. *Cordia cremersii* and *C. marioniae* belong in section *Varronia*, and *C. fanchoniae* in section *Myxa*. *Cordia marioniae* is known from the Rupununi savanna in the south of Guyana; the two other species have been collected in French Guiana.

Key words: Boraginaceae, *Cordia*, French Guiana, Guyana, sect. *Myxa*, sect. *Varronia*.

Only a few species of Boraginaceae have been added to those known from the flora of the Guianas since the last treatments by Johnston (1932, 1935), and addition by Uittien (1937). In contrast, recent treatments from neighboring countries (Estrada S., 1995; Gaviria, 1987; Taroda & Gibbs, 1986) described many new taxa, but none of those have been documented to extend into the Guianas. During the preparation of the treatment of the Boraginaceae for *Flora of the Guianas*, some of the collections studied proved to be new species. *Cordia wurdackiana* was published recently (Feuillet, 1997) and three new species of *Cordia* L. are described here, namely *C. cremersii* and *C. fanchoniae*, both from French Guiana, and *C. marioniae* from Guyana. *Cordia* is a large pantropical genus with an estimated 350 species (Miller, 2001); it is the largest genus in the Boraginaceae and mostly Neotropical in distribution. *Cordia* has not been treated as a whole since de Candolle (1845), the many modern studies have mostly been of limited geographic scope, and the genus is badly in need of monographic study.

CORDIA SECT. *MYXA* (ENDLICHER) DC.

Cordia sect. *Myxa* (Endlicher) DC. is by far the largest section of *Cordia*, and the only one of the six currently recognized sections to be well represented in all tropical regions. It is a group of ca. 200 species (Miller, 2001) that are mostly trees with small white flowers in loose panicles and calyces that are explanate under the fruits. It includes all but two of the Old World species and the majority of the New World rain forest species. Seventeen of the 29 species of *Cordia* in the Guianas belong in section *Myxa*.

Cordia fanchoniae Feuillet, sp. nov. TYPE: French Guiana. Piste de Saint-Élie, 20 km from RN 1, 5°20′N, 53°00′W, 8 Nov. 1995 (fl & fr), *M.-F. Prévost & A. Cortès 3188* (holotype, US; isotypes, CAY(2), NY, P). Figure 1A–C.

Species ad *Cordiam* sectionem *Myxam* pertinens; brevibus ramosisque cymosis inflorescentiis, supra glabris et infra minuti-pilosis foliis, rubris, atromaculatis, obliquis fructibus notabilis.

Woody monocaulous plant 0.5–1.5 m tall, blooming as small as 0.50 m tall. Internodes 3–20 mm long. Stems densely short strigose. Leaves: petiole canaliculate, short, up to 1.5 cm long, densely short pubescent; blades narrowly oblong to elliptic or oblanceolate, 14–32 × 4–8 cm, acute and slightly decurrent at base, acuminate at apex, margin entire and recurved, with 8 to 12 main lateral veins on a side, the adaxial face drying brown, glabrous to glabrescent, veins concolorous, main lateral veins impressed, smaller veins raised, sometimes somewhat white, the abaxial face drying tan to olive-green, seeming glabrescent except on the veins, but actually with some obscure pubescent, main lateral veins raised, brown, tertiary veins yellowish, somewhat obscure. Inflorescence axillary, condensed, cymose, branched, branches scorpioid, to 2 cm long, blooming acropetally, densely 15- to 20-flowered; calyx barrel-shaped at anthesis, 4–5 mm long, 5-lobed, with a dense indumentum of thick straight hairs outside, short appressed pubescent inside, lobes triangular, up to 1.5 mm long, later torn into a 5- to 8-toothed, nearly flat plate under the fruit, whitish, glossy and glabrous inside; corolla white, tube 5 mm long, lobes oblong, rounded at apex, 1.5–2 × 1.5 mm, reflexed against the calyx, glabrous; in male flowers: stamens inserted on the corolla tube below middle, exserted, nearly 2 mm out of the corolla tube, filaments 3.0–3.5 mm long, long hirsute at base, glabrous above, anthers sagittate or V-shaped; ovary lacking, replaced by a tuft of long hairs; in female flowers: no stamen observed, ovary

Figure 1. A–C. *Cordia fanchoniae* Feuillet. —A. Leafy stem with inflorescences, the apical leaf showing venation pattern. —B. Open corolla and stamens. —C. Gynoecium. D–F. *Cordia cremersii* Feuillet. —D. Leafy stem with inflorescence, the apical leaf showing venation pattern. —E. Open corolla and stamens. —F. Gynoecium. G–I. *Cordia marioniae* Feuillet. —G. Leafy stem with inflorescences, the apical leaf of the lateral branch showing venation pattern. —H. Open corolla and stamens. —I. Gynoecium. (A–C based on the US holotype, *Prévost & Cortès 3188*; D–F based on the US holotype, *Cremers & de Granville 13934*, and a photograph of a live plant by J.-J. de Granville; G–I based on the US holotype, *Jansen-Jacobs et al. 3931*.)

glabrous, broadly conical, 0.5–0.8 mm, 5-lobed at base, style hirsute below 1st branching, glabrous above, branched 1.0–1.2 and 1.5–1.7 mm above the base, 4 terminal segments 1.2–1.5 mm long, swollen and somewhat 2-lobed at apex. Fruit a drupe, oblique in the calyx, 10 × 6 mm, base asymmetric, round, tapering to the slightly acute (when fresh) apex, mucronate, glabrous, abscission of the style when fruit becomes bright red, black around insect exit hole; stone not seen (all fruits emptied by insect larvae).

Cordia fanchoniae is known only from the basin of the lower Sinnamary River in the center of northern French Guiana. The type was collected on an abandoned timber unloading track. Flowering in June–July and November; fruiting in June and November.

This new species most closely resembles *Cordia nervosa* Lamarck of *C.* sect. *Myxa*, also from the Guianas. *Cordia fanchoniae* differs from *C. nervosa* in having longer and narrower leaf blades that are acute and slightly decurrent at the base, in its calyx densely hairy outside and clearly 5-lobed, and glabrous fruits. It differs from all other species of *Cordia* sect. *Myxa* of the Guianas in its axillary inflorescences. All collections, *Prévost & Cortès 3188* and *Loubry 1194* (0.5 m tall), and *Molino et al. 1854* (1.5 m), have a monocaulous habit and axillary inflorescences. Whether or not the stem later branches and has terminal inflorescences, this monocaulous growth may be viewed as a sign of neoteny equivalent to the sterile first growth unit typical of *Cordia* sect. *Myxa*.

The architectural model corresponding to the growth pattern of *Cordia fanchoniae* is Corner's model as defined by Hallé and Oldeman (1970) and Hallé et al. (1978). As shown in *Prévost & Cortès 3188* (CAY, sheet 2), after a traumatic reiteration as defined by Oldeman (1974), the new shoot is monopodial, unbranched, and the inflorescences are axillary. Previously known architectural models in *Cordia* are Prévost's (sect. *Myxa*: spp.), Fagerlind's (sect. *Gerascanthus* (Browne) G. Don: *C. alliodora* (Ruiz & Pavón) Oken), and Champagnat's (sect. *Varronia*: spp.).

Cordia fanchoniae is named to honor my friend and collector of the type, Marie-Françoise "Fanchon" Prévost, who has a keen eye for unusual species and plant architecture.

Paratypes. FRENCH GUIANA. Near the lake of Petit Saut dam (Sinnamary River), 5°03′N, 52°54′W, 3 July 1997 (fl), *J.-F. Molino, D. Sabatier & D. Paget 1854* (CAY, US); Piste de Saint-Élie, 22 km from RN 1, 5°20′N, 53°00′W, 18 June 1991 (fl & fr), *D. Loubry 1194* (CAY).

Cordia sect. *Varronia* (Browne) G. Don

Cordia sect. *Varronia* (Browne) G. Don is well represented in open vegetation in Neotropical regions. It is a group of ca. 100 American species (Miller, 2001) with a shrubby habit and inflorescences condensed in a spike or a head and calyces cupular or campanulate, partially or totally enclosing the fruits. In the Guianas, 8 of the 29 species of *Cordia* belong in section *Varronia*.

Cordia cremersii Feuillet, sp. nov. TYPE: French Guiana. Bassin de l'Oyapock, Roche Touatou, 150 m, 2°57′N, 52°32′W, 16 May 1995 (fl), *G. Cremers & J.-J. de Granville 13934* (holotype, US; isotypes, CAY, NY, P, U). Figure 1D–F.

Species ad *Cordiam* sectionem *Varroniam* pertinens; 1.2 × 1 cm globosis capitibus inflorescentiarum, 0.7–1.0 cm longis pedunculis sub anthesi, 1.5–2 cm longis post anthesin, pubescentibus foliis notabilis.

Shrub 1.5–2 m tall. Twigs with internodes 6–9 mm long, pubescent near the apex. Leaves: petioles to 5 mm long, densely hairy; blades ovate or less often elliptic, 3–8 × 1.2–3 cm, cuneate at base, acute at apex, margin serrulate to doubly serrate, upper surface drying dark brown, densely pubescent becoming glabrescent, veins impressed except a narrow and raised midrib, lower surface with a white and dense pubescence, venation brown showing through, veins raised including a wide midrib, 5 to 7 main veins on a side. Inflorescence terminal and axillary, condensed heads 1.2 × 1 cm, on a short peduncle 0.7–1.0 cm long at anthesis, becoming 1.5–2 cm long when fruiting, 15- to 25-flowered; calyx funnel-shaped, 4 mm long, including five 0.5–1.5 mm long teeth, yellow-green at anthesis, with scattered white trichomes outside, slightly denser toward the apex, much denser in bud; corolla tube 4–5 mm long, 5 lobes broadly elliptic, rounded at apex, reflexed, 7–10 × 5 mm, white, pubescent to glabrescent; stamens inserted on the corolla tube at or slightly below middle, barely exserted, filaments 1.5–2 mm long, with a tuft of hair at base, anthers subglobose, ca. 0.5 mm long; ovary conical, obtuse at apex, 0.5–0.6 mm long, glabrous, style glabrous, branched 0.7–0.8 mm and 1.1–1.3 mm from base, the 4 terminal segments ca. 0.7 mm long, not swollen at apex. Fruit not seen.

Cordia cremersii is known only from southeast French Guiana from the type collection discovered on the southern slope of Roche Touatou at about 150 m elevation. The population was growing at the limit of the brush-islands on the "savane roche." Flowering in May.

This new species most closely resembles *Cordia harleyi* Taroda of *C.* sect. *Varronia*, known only from the state of Bahia (Brazil). *Cordia cremersii* differs from *C. harleyi* in its shorter petioles, longer and narrower leaf blades that are cuneate (vs. truncate at base) and acute to long acute at apex (vs. obtuse or rounded), its denser and longer pubescence on the adaxial surface of the leaves, and its shorter inflorescence peduncle and somewhat smaller corolla.

Cordia cremersii is named to honor Georges Cremers, a discoverer of this new species, as well as a tireless field botanist with whom I have collected plants many times in French Guiana.

Cordia marioniae Feuillet, sp. nov. TYPE: Guyana. Rupununi District: Dadanawa, 120 m elev., 2°49′N, 59°31′W, 6 June 1995 (fl & fr), *M. J. Jansen-Jacobs, B. J. H. ter Welle, C. Gustafsson & V. James 3931* (holotype, US; isotypes, BRG, GB, MO, U). Figure 1G–I.

Species ad *Cordiam* subg. *Varroniam* pertinens; spicatis inflorescentiis, 3–5 cm longis pedunculis, obovatis foliis, supra scabridis, infra pubescentibus, late rotundato apice notabilis.

Shrub. Twigs with long internodes 1–2 cm long. Leaves: petioles 5–8 mm long, with very short pubescence; blades obovate, 3.5–8 × 2–4.5 cm, attenuate at base, broadly rounded at apex, margin obscurely and loosely serrate above middle, trichomes appressed, short, stiff, white above, longer, soft, dense, erect, curved beneath, midrib and secondary veins visible above, beneath tertiary venation netting visible, drying chocolate brown above, paler with dark veins beneath, 4 to 6 main veins on a side. Inflorescence spikes blooming basipetally, terminal and in a few apical axils, peduncle not adnate to petiole, 3–5 cm long, fertile part 3–6 cm long, densely 15- to 40-flowered; calyx pale green, cup-shaped, about 2 mm long, including 5 triangular lobes, 0.5 mm long, with a white, appressed indumentum outside; corolla white, tube 5 mm long, salveriform, 5 lobes reflexed, round, emarginate at apex, ca. 0.5–0.6 × 0.7–0.8 mm, glabrous; stamen inserted on the corolla tube ¼ of the length from the base, barely exserted, filaments 2 mm long, with a tuft of hair on the proximal ⅓, anthers broadly elliptic; ovary broadly conical, ca. 0.7 mm long, glabrous, style glabrous, divided twice in 2 branches (nearly at the same point) ca. 1.8 mm from base, 4 terminal segments ca. 1.7 mm long, narrowly swollen in the apical half. Young fruit spherical.

Cordia marioniae is known from two collections discovered 150 years apart in the Rupununi District, near Dadanawa close to the southwest corner of the Kanuku Mountains. The type collection is from a shrub growing in a small, rather dry bush-island in the savanna. The older paratype, *Schomburgk 1304*, from the bank of the Rupununi does not have any flower or fruit left on the peduncles, but shows the typical leaf shape of the species. Dadanawa is close to the Rupununi River where the plant probably grew in the clear, narrow gallery forest. Flowering and fruiting in May–June.

Cordia marioniae is easily set apart from all other species of section *Varronia* by the obovate shape of the leaf blades. It is also characterized by the straight, thin inflorescence peduncle.

Cordia marioniae is named after Marion Jansen-Jacobs, collector of the type, colleague, and long-time student of the flora of the Guianas with whom I had the privilege to collect plants both in Guyana and French Guiana.

Paratype. GUYANA. "Ufer des Flüsses Rüpününi in Brit. Güiana," May 1843, *Rich. Schomburgk 1304* (B).

KEY FOR *CORDIA* SECT. *VARRONIA* IN THE GUIANAS

1a. Inflorescences capitate.
  2a. Inflorescences branched; flower heads < 5 mm diam . . . . . *C. polycephala* (Lamarck) I. M. Johnston
  2b. Inflorescences unbranched; flower heads > 5 mm diam.
    3a. Peduncles > 5 cm long; corollas > 3 cm long *C. grandiflora* (Desvaux) Kunth
    3b. Peduncles < 3 cm long; corollas < 2 cm long . . . . . *C. cremersii* Feuillet
1b. Inflorescences spicate.
  4a. Inflorescence peduncles adnate to the petiole base.
    5a. Leaf blades adaxially dull; inflorescences densely flowered (calyces touching each other and without gaps in the fertile part on the inflorescences); calyx lobes acuminate, acumen free in closed buds . . . . . *C. tomentosa* (Lamarck) Roemer & Schultes
    5b. Leaf blades adaxially shiny; inflorescences loosely flowered (with gaps in the fertile part on the inflorescences between flowers or groups of flowers); calyx lobes not acuminate . . . . . *C. schomburgkii* DC.
  4b. Inflorescence peduncles not adnate to the petiole base.
    6a. Leaf blades adaxially glabrous; inflorescences only terminal . . . . . *C. curassavica* (Jacquin) Roemer & Schultes
    6b. Leaf blades adaxially hairy; inflorescences terminal and axillary.
      7a. Leaf blades obovate, widely rounded at apex . . . . *C. marioniae* Feuillet

7b. Leaf blades ovate, acute at apex
. . . . *C. stenostachya* Killip ex Gaviria

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Chamaecrista mwangokae (Fabaceae, Caesalpinioideae), a New Species from the Southern Highlands of Tanzania

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ABSTRACT. We discuss the historical usage of the genus *Chamaecrista* (Fabaceae, Caesalpinioideae) in Africa, describe and illustrate the new species *C. mwangokae* from southern Tanzania, reduce *C. hildebrandtii* to taxonomic synonymy under *C. zambesica*, and provide a key to the East African species of *Chamaecrista* with stipitate petiolar glands.

Key words: Caesalpinioideae, *Chamaecrista*, Fabaceae, Tanzania.

Within Fabaceae subfamily Caesalpinioideae, Irwin and Barneby (1982) placed *Cassia* L., *Chamaecrista* Moench, and *Senna* Miller in tribe Cassieae, subtribe Cassiinae. *Chamaecrista* is a genus of approximately 330 species (G. P. Lewis, pers. comm.), with greatest diversity in Central and South America and a secondary center of diversity in tropical Africa (Polhill & Thulin, 1989; Thulin, 1993; Du Puy & Rabevohitra, 2002). Although Meyer (in Meyer & Drège, 1836) followed the generic concept of Moench (1794) and named a number of new South African species in *Chamaecrista*, the vast majority of African regional floristic treatments of Fabaceae predated the formal reinstatement of the genus in the New World by Irwin and Barneby (1982). Thus most of the well-known African floristic authors of the 19th (e.g., Harvey, 1862; Oliver, 1871) and 20th centuries (e.g., Steyaert, 1952; Keay, 1958; Brenan, 1967; Aubréville, 1968, 1970) treated *Chamaecrista* as part of a very broadly circumscribed *Cassia*, a circumscription maintained even later by Lebrun and Stork (1992). In the 20th century only Polhill and Thulin (1989) and Thulin (1993) recognized *Chamaecrista* in tropical African floristic treatments, followed in the present century by Du Puy and Rabevohitra (2002) for Madagascar.

Greene (1897) laid the foundation for a worldwide circumscription of *Chamaecrista* and soon afterward (1899) began the transfer of African species of *Cassia* to *Chamaecrista*. Standley (1917) followed with a few more new combinations in *Chamaecrista*, but without reference to Greene or providing any further explanation. Following the revision of the New World species by Irwin and Barneby (1982), Lock (1988) provided most of the remaining combinations needed for African species. The tropical African species now included in *Chamaecrista* (Lock, 1989) may be differentiated from *Cassia* and *Senna* by the following key, based on the key to species of *Cassia* sensu lato by Brenan (1967: 51–58) with additional characters from Irwin and Barneby (1982: 2–3), Polhill and Thulin (1989: 50), and Thulin (1993: 343).

1a. Petioles and rhachides of leaves eglandular.
  2a. Filaments of 2 or 3 lower stamens with an S-shaped curve above base, their anthers introrsely dehiscent by slits; legume indehiscent, cylindrical or slightly compressed, 20–90 cm long . . . . . *Cassia*
  2b. Filaments of all stamens straight or incurved, their anthers terminally dehiscent by slits or pores; legume dehiscent, flattened, or winged or ridged along each valve, almost always < 20 cm long (almost cylindrical and longer in the frequently introduced *Senna spectabilis* (DC.) H. S. Irwin & Barneby).
    3a. Leaflets in 2 pairs; stem with glandular-based bristles; seeds without areoles . . . . . *Chamaecrista absus* (L.) H. S. Irwin & Barneby
    3b. Leaflets in 3 or more pairs; stem without glandular-based bristles; seeds usually with areoles . . . . . *Senna*
1b. Petioles and/or rhachides of leaves with conspicuous glands (extrafloral nectaries).
  4a. Leaflets with a short but distinct petiolule; glands of petiole or rhachis mounded or elongate, secreting nectar from a convex surface; pedicels ebracteolate; sepals obtuse or rounded at apex; legume indehiscent or slowly dehiscent, the valves never twisting; seeds usually with areoles . . . . . *Senna*
  4b. Leaflets sessile or with a short pulvinulus; glands of petiole or rhachis cup-shaped or flat, sometimes stipitate, secreting nectar from a concave or flat surface; pedicels with 2 bracteoles near or above middle; sepals acute or acuminate at apex; legume elastically dehiscent with twisting valves; seeds without areoles . . . . . *Chamaecrista*

Under "*Cassia* sp. A," Brenan (1967: 84) described, but did not formally name, a distinctive

Chamaecrista from Mufindi District in the Southern Highlands of Tanzania. Recent collections made during plant inventories conducted by the Tanzania Forest Conservation Group, an environmental NGO based in Dar es Salaam, included material unquestionably corresponding to *Cassia* sp. A, although the material designated below as the type of the new species lacks additional stipitate glands on the leaf rhachis.

Chamaecrista mwangokae Gereau & G. M. Walters, sp. nov. TYPE: Tanzania. Iringa Region, Mufindi District: public land between Mdabulo and Igoda Villages along road to Luhunga Village, 8°30′40″S, 35°30′02″E, 1675 m, 20 Oct. 2000, *M. A. Mwangoka 1741* (holotype, NHT; isotypes, BRIT, K, MO, S, tfcg (reference collection of Tanzania Forest Conservation Group)). Figure 1.

Haec species inter congeneros Africae orientalis glandulis petiolaribus stipitatis praeditos ad *Chamaecristam grantii* et *C. zambesicam* quoad foliolorum costam excentricam sed non submarginalem maxime accedit, sed ab eis foliolorum venatione valde reticulata atque petalis 14–18 mm longis distinguitur.

Perennial herb with thick woody rootstock; stems spreading or ascending, 10–30 cm long, sparsely hirsute to glabrous. Stipules acuminate, parallel-veined, (3.0–)3.9–9.0 × 1.0–2.0 mm; petiole (3–)5–7 mm long; leaf rhachis channeled above, (1.0–)2.0–4.5(–5.8) cm long; gland on petiole just below lowest leaflet pair, occasionally with additional glands along rhachis between upper leaflet pairs, stipitate, the stipe (0.2–)0.4–1.5 mm long, the head (0.2–)0.3–0.4(–0.8) mm wide; leaflets in 2 to 11 pairs, glabrous except for frequently ciliate margins and costa, asymmetrically elliptic with proximal margin rounded, distal margin straight and parallel to strongly excentric costa, largest leaflets 9.5–12.0(–17.0) × (2–)4–8 mm; costa (0.3–)0.9–1.7(–2.5) mm from distal margin; secondary veins parallel only in basal half, branched and reticulate in distal half; tertiary venation strongly reticulate on both surfaces. Inflorescence 1- or 2-flowered; pedicels (2.4–)3.8–6.2(–9.4) cm long; bracteoles cordate, acute, located in uppermost ⅓ to $\frac{1}{10}$ of pedicel, 3.0–5.1 × 0.9–2.0 mm. Sepals bright red in living material, (3–)9–13 × 2.0–4.1 (–5.0) mm; petals yellow, 14–18 × 9–11 mm; stamens 10, the anthers 0.3–0.8 mm long; ovary densely pubescent. Mature legume not seen; immature legume pubescent, ca. 4.5 cm long; seeds unknown.

Paratypes. TANZANIA. **Iringa Region:** Mufindi District, Ikanga near Mdabulo, 8°30′S, 35°31′E, 26 Aug. 1952, *W. Carmichael 110* (K); Sao Hill, 8°30′S, 35°15′E, 1800 m, 16 Oct. 1987, *J. Lovett, P. A. Keeley & M. S. Keeley 950* (K, MO); Irundi, ca. 8°27′S, 35°15′E, 1830–1980 m, 19 Sep. 1971, *C. F. Paget-Wilkes 952* (MO); Irundi Hill, Sao Hill, ca. 8°27′S, 35°15′E, 1980 m, Dec. 1963, *J. Procter 2469* (K); "Mufindi," 1830 m, Oct. 1931, *R. R. Staples 232* (K).

The new species is known only from the above-cited specimens from Mufindi District in Iringa Region, southern Tanzania; J. M. Lock (pers. comm.) has confirmed that there are no specimens of *Chamaecrista mwangokae* at K from the *Flora Zambesiaca* area. Its conservation status must be considered as data deficient, although more recent collections (not examined) may allow more precise evaluation. From collectors' field notes, *Chamaecrista mwangokae* occurs in grassland and stony grassy hillsides, associated with *Aloe* (Asphodelaceae), *Apodytes dimidiata* E. Meyer ex Arnott (Icacinaceae), *Asparagus* (Asparagaceae), *Dodonaea viscosa* Jacquin (Sapindaceae), *Faurea* (Proteaceae), *Helichrysum* (Asteraceae), and *Protea* (Proteaceae). The new species is nearly always found in recently burned areas; unsuccessful attempts to locate it in unburned areas in October 2002 may indicate that *C. mwangokae* is dependent upon fire for induction of flowering.

The specific epithet commemorates the collector of the type, Moses Anyelwisye Mwangoka, whose collections under the direction of the Tanzania Forest Conservation Group have been of exceptional value to the taxonomic and phytogeographic study of the Eastern Arc Mountains of Tanzania.

During study of other East African species of *Chamaecrista* with stipitate petiolar glands, careful examination of type specimens and available herbarium material formerly assigned to *C. hildebrandtii* (Vatke) Lock and *C. zambesica* (Oliver) Lock revealed no consistently reliable means of distinguishing these species. Brenan (1967: 84–85) primarily distinguished these species on the basis of stipe length: 0.3–0.7 mm for *C. hildebrandtii* and 1.00–1.25 mm for *C. zambesica*. Our actual measurements of stipes showed a nearly continuous gradation between 0.1 and 1.3 mm. With no consistent morphological distinction and overlapping geographic ranges, we here synonymize these two species under the older binomial.

Chamaecrista zambesica (Oliver) Lock, Kew Bull. 43: 338. 1988. Basionym: *Cassia zambesica* Oliver, Fl. Trop. Afr. 2: 280. 1871. TYPE: Mozambique. Shamwara, *Kirk s.n.* (holotype, K).

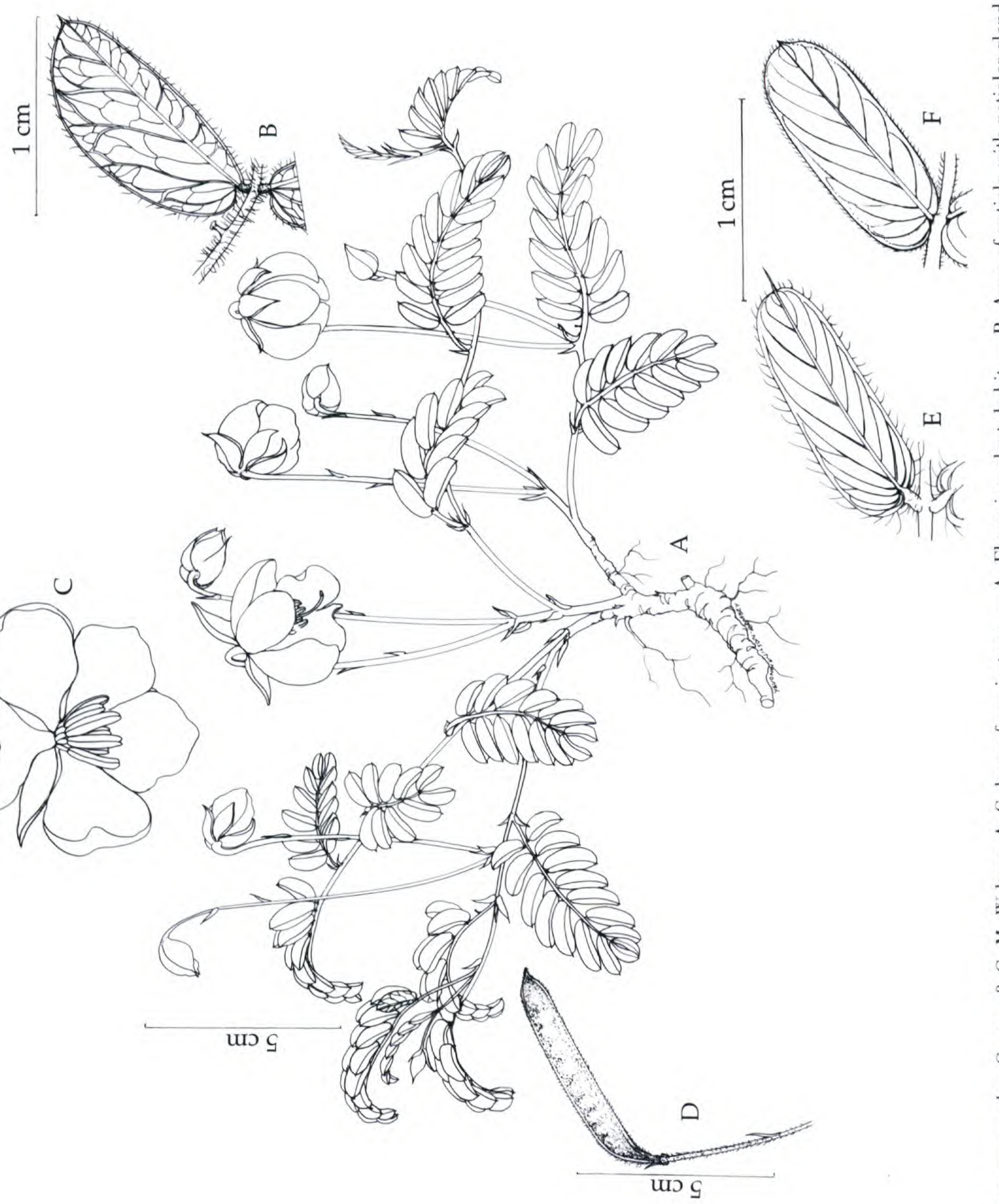

Figure 1. *Chamaecrista mwangokae* Gereau & G. M. Walters. A–C drawn from isotype. —A. Flowering plant, habit. —B. Apex of petiole with petiolar gland and basal leaflet pair. —C. Open flower, frontal view. —D. Immature fruit. —E. Leaflet pair of *C. zambesica, M. E. Archbold 1016* (MO). —F. Leaflet pair of *C. grantii, G. P. Leedal 1164* (K).

Chamaecrista hildebrandtii (Vatke) Lock, Kew Bull. 43: 336. 1988. Syn. nov. Basionym: *Cassia hildebrandtii* Vatke, Oesterr. Bot. Z. 30: 80. 1880. TYPE: Kenya. Teita Dist., Ndara Hill, *Hildebrandt 2464* (holotype, B†; isotype, K).

Selected specimens. UGANDA. **E Ankole Dist.:** Nyakatokye-Buyene, Kashari, 0°22′S, 30°31′E, 1680 m, 17 Mar. 1986, *P. K. Rwaburindore 2245* (MO). RWANDA. Biumba, Région de Mutara, env. Mimuli, colline Rutengura, 1400–1450 m, 8 Oct. 1959, *G. Troupin 11811* (MO). KENYA. Kiambu Dist., Muguga North, 2040 m, 15 Oct. 1953, *B. & L. D. Verdcourt 1022* (MO). TANZANIA. **Kilimanjaro Region:** Same Dist., S Pare Mountains, Suji Village, Hekano, 4°21′35″S, 37°51′20″E, 1480 m, 31 Mar. 1999, *J. A. Mlangwa 116* (MO, NHT). **Pwani Region:** Kisarawe Dist., Mkamba, ca. 70 km SW of Dar es Salaam, 70 m, 4 June 1972, *B. Mhoro & V. F. Malima DSM 2588* (DSM, MO).

Key to East African Species of *Chamaecrista* with Stipitate Petiolar Glands

1a. Leaflets with costa excentric but not submarginal, (0.3–)0.5–2.5 mm from distal margin.
  2a. Leaflets with secondary veins branched and reticulate in distal half and tertiary venation strongly reticulate; petals 14–18 mm long . . . . . *C. mwangokae* Gereau & G. M. Walters
  2b. Leaflets with secondary venation parallel nearly to margin and tertiary venation inconspicuous; petals 4–14 mm long.
    3a. Stipitate glands present on leaf rhachis between some or all pairs of leaflets in addition to petiolar gland; petals 10–14 mm long . . . . *C. grantii* (Oliver) Standley
    3b. Stipitate gland present only on petiole, rarely sessile or subsessile glands present on rhachis between pairs of leaflets; petals 4–12 mm long . . . . . *C. zambesica* (Oliver) Lock
1b. Leaflets with costa marginal or submarginal, 0–0.4 mm from distal margin.
  4a. Petiolar gland with stipe 1.0–2.2 mm long; pedicel 3–6 mm long . . . . . *C. fallacina* (Chiovenda) Lock
  4b. Petiolar gland with stipe 0.1–0.8 mm long; pedicel 9–30 mm long.
    5a. Leaf rhachis crenate-crested; petals 3.0–5.5 mm long . . . . . *C. gracilior* (Ghesquière) Lock
    5b. Leaf rhachis channeled; petals 7–10 mm long.
      6a. Leaflets in 4 to 13 pairs; pedicel with appressed pubescence; petals yellow, orange, or red at base; legume 1.2–3.3 cm long . . . . . *C. usambarensis* (Taubert) Standley
      6b. Leaflets in 11 to 43 pairs; pedicel with pubescence short and dense, not appressed, or with trichomes 1–2 mm long perpendicular to pedicel; petals yellow; legume 2.5–5.0 cm long.
        7a. Stipitate gland present only at apex of petiole; stipe of gland 0.1–0.2 mm long; petals 7.0–7.5 mm long . . . . . *C. fenarolii* (Mendonça & Torre) Lock
        7b. Stipitate glands sometimes present in lower part of petiole and/or on rhachis between lower pairs of leaflets; stipe of gland 0.25–0.75 mm long; petals 8–10 mm long . . . . . *C. katangensis* (Ghesquière) Lock

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The Genus *Uvariopsis* (Annonaceae) in Tropical Africa, with a Recombination and One New Species from Cameroon

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ABSTRACT. *Uvariopsis submontana* Kenfack, Gosline & Gereau (Annonaceae) is described from premontane habitats in western Cameroon. The new species is morphologically most similar to *U. korupensis* Gereau & Kenfack, recently described from lower elevations in western Cameroon. The monotypic genus *Dennettia* Baker f. is completely consistent with the morphological and palynological circumscription of *Uvariopsis* Engler, and is included in the latter genus under the new combination *U. tripetala* (Baker f.) G. E. Schatz. A key to the 16 species of this tropical African genus is presented.

RÉSUMÉ. *Uvariopsis submontana* Kenfack, Gosline & Gereau (Annonaceae) est décrit d'habitats prémontagnards de l'Ouest du Cameroun. Quant à sa morphologie, la nouvelle espèce ressemble au plus près l'*U. korupensis* Gereau & Kenfack, récemment décrit d'altitudes plus basses de l'Ouest du Cameroun. Le genre monotypique *Dennettia* Baker f. est tout à fait consistent avec la circonscription morphologique et palynologique d'*Uvariopsis* Engler et est inclu dans celui-ci sous la nouvelle combinaison *Uvariopsis tripetala* (Baker f.) G. E. Schatz. Une clé des 16 espèces de ce genre de l'Afrique tropicale est présentée.

Key words: Annonaceae, Cameroon, *Dennettia*, tropical Africa, *Uvariopsis*.

Uvariopsis Engler (Engler & Diels, 1899) is a strictly African genus of shrubs and trees in the Annonaceae, placed by Fries (1959) in subfamily Annonoideae, tribe Unoneae, and "Monanthotaxis-Gruppe." Using primarily floral characters, Heusden (1992) included *Uvariopsis* in his "Uvariastrum-group" with the exclusively African genera *Dennettia* Baker f., *Dielsiothamnus* R. E. Fries, *Meiocarpidium* Engler & Diels, *Mischogyne* Exell, *Monocyclanthus* Keay, *Polyceratocarpus* Engler & Diels, *Uvariastrum* Engler, and *Uvariodendron* (Engler & Diels) R. E. Fries. Based on characters of the fruit and seeds, Setten and Koek-Noorman (1992) put *Uvariopsis* in their "Group 13" with *Dennettia*, *Mischogyne*, *Uvariastrum*, *Uvariodendron*, and *Hexalobus* A. DC., another exclusively African genus. In a phylogenetic analysis based on a large assembly of characters (Doyle & Le Thomas, 1996), *Uvariopsis* is found among the genera on the most advanced branch of the family ("annonoid clade").

Uvariopsis may be distinguished from neighboring genera of Annonaceae by the following combination of characters (Keay, 1954; Robson, 1960; Le Thomas, 1969; Verdcourt, 1971; Heusden, 1992; Setten & Koek-Noorman, 1992; Doyle & Le Thomas, 1994, 1996): indument simple; sepals 2 or 3, connate at least at base; petals 3 or 4, uniseriate, valvate; floral receptacle elongate at base and apex; anthers extrorse or latrorse, discoid at apex; pollen in flat tetrads; gynoecium and fruit apocarpous, composed of several free mericarps; stigmas erect; ovules numerous, biseriate; fruit pedicellate, the mericarps indehiscent, sessile or with stipe shorter than fertile part; seeds smooth (not tuberculate), the endocarp with lamelliform ruminations.

In their revision of the genus, Robyns and Ghesquière (1933) recognized ten species of *Uvariopsis* in western and central tropical Africa. A total of six new species have subsequently been described from Gabon (Pellegrin, 1948), Angola (Exell & Mendonça, 1951), West Africa (Keay, 1952), Tanzania (Verdcourt, 1986), and Cameroon (Gereau &

Kenfack, 2000). Keay (1954: 50, 47) placed *Uvariopsis pedunculosa* (Diels) Robyns & Ghesquière in synonymy with *U. dioica* (Diels) Robyns & Ghesquière, and reduced *Uvariopsis chevalieri* Robyns & Ghesquière to synonymy under *Uvariastrum elliotianum* (Engler & Diels) Sprague & Hutchinson. Le Thomas (1969: 298, 303) placed *Uvariopsis batesii* Robyns & Ghesquière in synonymy with *U. solheidii* (De Wildeman) Robyns & Ghesquière and accepted the transfer of *Thonnera congolana* De Wildeman into *Uvariopsis*. The number of currently recognized species thus comes to 14.

As is evident from the key, the majority of species of *Uvariopsis* are strictly trunciflorous. However, recent explorations at medium elevations in wet submontane forest in South West Province, Cameroon, have revealed the presence of a new species with a more extreme degree of trunciflory than any previously known species, with inflorescences densely covering the base of the tree and extending to several meters above the ground. In the present article we describe this new species and transfer the monotypic genus *Dennettia* into *Uvariopsis*.

Uvariopsis submontana Kenfack, Gosline & Gereau, sp. nov. TYPE: Cameroon. South West Province: Ndian Division, Rumpi Hills, ca. 800 m, 4°57′N, 9°02′E, 6 Feb. 2000 (fl), *D. Kenfack 1334* (holotype, YA; isotypes, K, MO, SCA). Figure 1.

Haec species quoad inflorescentias omnes truncifloras flores manifeste pedicellatos alabastrum florale ovoideo-conicum pyramidaleve atque petalos quattuor basi connatos ad *U. korupensem* maxime accedit, sed ab ea lamina foliari 16–38 × 5–11 cm (vs. 30–52 × 9–14 cm) atque praecipue sepalis 5–10 (vs. 2–5) mm longis distinguitur.

Tree 8–15(–25) m tall, to 30 cm DBH, monoecious; bark dark green to black; slash pale yellow to light brown, quickly oxidizing to brown; young branchlets appressed pubescent, glabrescent; internodes 2.0–4.5 cm long. Petiole 3–8 mm long, 3–5 mm thick, appressed pubescent; leaf blade chartaceous to subcoriceous, oblanceolate to oblong-oblanceolate, 16–38 × 5–11 cm, rounded to subcordate at base, acutely acuminate at apex, glabrous above, glabrous or with very sparse appressed pubescence on surface beneath; midrib glabrous and slightly impressed above, prominent and sparsely pubescent beneath; secondary veins 9 to 18 on each side of midrib, brochidodromous, joined and arcing 4–7 mm from margin, slightly raised above, more so beneath; intersecondary veins ca. 0.75 length of secondaries; tertiary veins reticulate, raised beneath. Inflorescences cauliflorous, covering base of tree in dense patches of up to 500 flowers, sparser at 2 m, ceasing before first branches at 6–8 m above ground; individual fascicles difficult to discern but apparently consisting of 6 to 50 flowers each; staminate and pistillate fascicles arising from separate brachyblasts, the staminate above, the pistillate at and near base of bole; bracts 2 to 4 at base of pedicel, ovate-orbicular, 1.0–1.6 mm long and wide; pedicels ascending-puberulent, the staminate 2.5–5.0 cm long, the pistillate 3–6 cm long in flower, in fruit 2.5–9.0 cm long, 3–7 mm thick. Immature flower buds sessile, ovate, completely covered by connate sepals that split into 2 as bud matures; mature flower buds ovoid-conic to pyramidal, 1.5–2.0 × 2.0–2.5 cm. Staminate flowers with sepals triangular, 5–10 × 6–12 mm, dark red, chartaceous, tomentulose without, glabrous within; petals 4, fleshy, lanceolate to ovate, acute at apex, 8–18 × 5–8 mm, connate at base for 4–9 mm, densely tomentose without, velutinous within; androecium a conical receptacle ca. 5 × 2–3 mm with > 100 stamens; stamens 0.4–0.7 × ca. 0.4 mm, with a very short filament and two lateral thecae ca. 0.8 length of stamen. Pistillate flowers with sepals broadly ovate, 6–8 × 6–9 mm, dark red, chartaceous, appressed puberulous without, glabrous within; petals 4, fleshy, lanceolate to broadly lanceolate, acute at apex, 15–17 × 5–7 mm, connate at base for 3–4 mm, tomentose without, velutinous within; gynoecium a globose receptacle 7–8 × 7–8 mm with 50 to 60 ovaries; ovary cylindrical to prismatic, 1.5–3.5 × 0.8–1.5 mm, villous; stigma sessile, glabrous, globular, ca. 0.5 mm diam.; ovules 9 to 12 in ranks of 4 to 6. Fruit composed of 9 to 25 nearly sessile, densely packed monocarps; monocarps pale green ripening dark yellow, sparsely appressed pubescent, oblong-ovoid, 1.7–8.0 × 1.3–5.5 cm, apiculate, constricted in dried specimens around two offset ranks of 3 to 6 seeds; seeds ovate-ellipsoid, 18–25 × 8–13 mm.

Habitat. Wet submontane forest on well-drained slopes at 780–1300 m altitiude.

Distribution. Cameroon. South West Province, Rumpi Hills to Mount Kupe; Littoral Province, near Yingui.

Phenology. Flowers collected in January, February, and May; fruit collected in June and July.

Vernacular name. "Michile" in Bakossi (*Cheek 7131*).

Paratypes. CAMEROON. **South West Province:** hunters' path from Kupe Village to mountain top, 4°47′N, 9°41′E, 840 m, *Cheek 7131* (K, SCA); below Kupe rock near Esense river, 4°47′N, 9°41′E, 900 m, *Elad 69* (SCA); Mt. Kupe, Shrike trail, 1200 m, *Wheatley 398* (SCA); Mt. Kupe, Shrike trail, 1100 m, *Cable 1221* (K); Mt. Kupe, Shrike trail, 4°49′22″N, 9°41′21″E, 1000 m, *Kenfack*

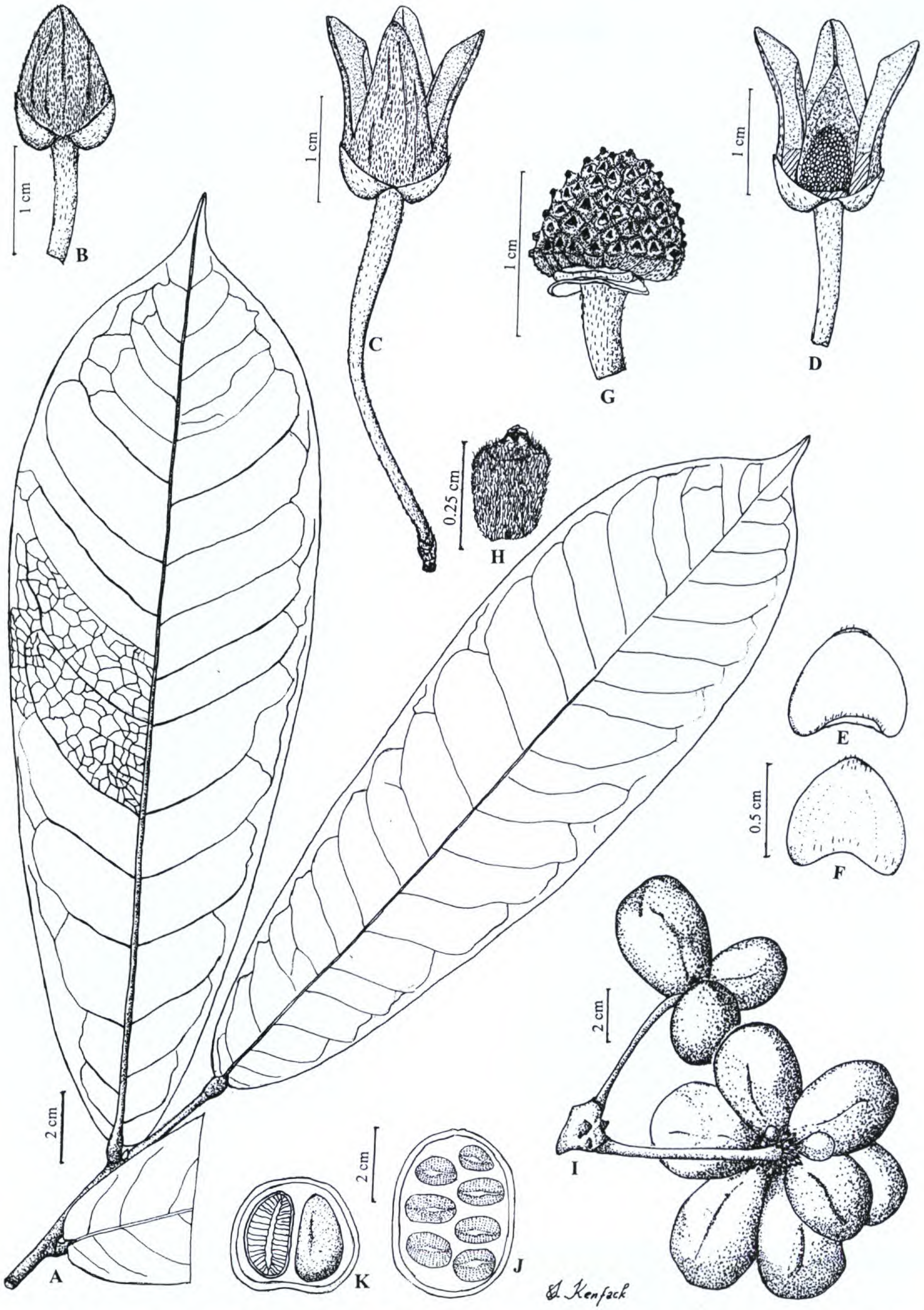

Figure 1. *Uvariopsis submontana* Kenfack, Gosline & Gereau. —A. Apex of branchlet with leaves and detail of venation. —B. Pistillate flower bud. —C. Staminate flower. —D. Staminate flower with one petal removed, lateral view. —E. Inner surface of sepal. —F. Outer surface of sepal. —G. Gynoecium. —H. Detail of one carpel, lateral view. —I. Infructescence. —J. Longitudinal section of mericarp. —K. Transverse section of mericarp. A–H drawn from the holotype, *Kenfack 1334* (YA); I–K drawn from *Kenfack 1373* (YA).

Figure 2. *Uvariopsis submontana* showing extreme trunciflory. Habitat shot in forest from Mt. Kupe, Cameroon, of *Cheek 7131* photographed by Martin Cheek in January 1995.

1373 (YA); Mt. Kupe, Shrike trail, 4°49′13″N, 9°41′17″E, 1110 m, *Kenfack 1375* (YA); Mt. Kupe, Shrike trail, 1300 m, *Kenfack 1376* (YA); path onto ridge leading to Kupe rock, 4°47′N, 9°41′E, 1000 m, *Cable 2736* (K); Mt. Kupe, permanent sample plot at 1200 m on Shrike trail, 4°50′N, 9°40′E, *Lane 131* (K); forest trail 2 km S from Etube-Tape Village, 4°51′N, 9°42′E, 1100 m, *Lane 490, 534* (K); forest on Mt. Kupe, 2 km E of Nyassosso Government School, 4°49′N, 9°42′E, 1000 m, *D. W. Thomas 9039* (MO). **Littoral Province:** Nkam Division, Bataba, ca. 10 km W of Yingui, 780 m, *Kenfack 1602* (YA).

Uvariopsis submontana is most similar to and probably most closely related to *U. korupensis* Gereau & Kenfack, and can be distinguished from it by the characters in the key to species (below). These two species occupy closely adjoining geographic ranges in Cameroon's South West Province, *Uvariopsis submontana* in submontane forest at 780 to 1300 m altitude, and *U. korupensis* in extremely wet lowland forest at 50 to 160 m. *Uvariopsis submontana* is apparently never sympatric with any other species of *Uvariopsis*.

Gereau and Kenfack (2000) cited two specimens from submontane elevations as paratypes of *Uvariopsis korupensis*. *C. Doumenge 446*, from forested slopes in the Bakossi Mountains at 1100 m, is a fruiting collection with leaf measurements (32 × 12 cm) at the low end of the range for *U. korupensis*, and may represent another population of *U. submontana*, although flowering material is needed for a positive determination. *D. W. Thomas 4477*, from the side of Mount Cameroon at 600 m, has flowers and fruit but no leaves. Although floral measurements (sepals ca. 3 mm long; petals ca. 17 × 10 mm) are consistent with those of *U. korupensis*, more complete material is needed, and *Thomas 4477* may represent another, still undescribed species.

Uvariopsis tripetala (Baker f.) G. E. Schatz, comb. nov. Basionym: *Dennettia tripetala* Baker f., Cat. pl. Oban 5, t. 2. 1913. TYPE: Nigeria. Benin City, Jan., *R. E. Dennett 44* (lectotype, designated here, K).

The monotypic genus *Dennettia* has traditionally been distinguished from *Uvariopsis* on the basis of its bisexual flowers with 3 sepals and 3 petals, versus unisexual flowers with 2 sepals and 4 petals. However, the description of *U. bisexualis* Verdcourt expanded the generic concept of *Uvariopsis* to encompass bisexual flowers. *Dennettia* occasionally exhibits flowers with 2 sepals and 4 petals, and *Uvariopsis congolana* (De Wildeman) R. E. Fries has 3 petals, making the number of perianth segments unreliable as a generic distinction. Pollen of *Dennettia* is very similar to that of *Uvariopsis*, being borne in tetrads and possessing a rugulate-perforate tectum, columellar infratectum, and basal foot-layer of irregular foliations; it differs from the pollen of *Uvariopsis* only by the absence of any granules in the infratectum (Le Thomas, 1981). All these arguments justify the unification of *Dennettia* with *Uvariopsis*. Baker (1913) described *Dennettia* with its one species, *D. tripetala*, on the basis of two syntypes, of which *Dennett 44* is here chosen as the lectotype over *Talbot 1496* to honor further the collector R. E. Dennett.

The key below distinguishes the 16 species of *Uvariopsis*, including the new species and the single species here transferred from *Dennettia*, primarily by floral characters.

Key to the Species of *Uvariopsis* in Tropical Africa

1a. Staminate (or hermaphrodite) inflorescences axillary or ramiflorous; pistillate inflorescences axillary, ramiflorous, or truncifloroous.
  2a. Flowers bisexual.
    3a. Sepals 2, petals 4; Tanzania . . . . . *U. bisexualis* Verdcourt
    3b. Sepals 3; petals 3 (or 4); Cameroon, Nigeria . . . . . *U. tripetala* (Baker f.) G. E. Schatz
  2b. Flowers unisexual, either staminate or pistillate.
    4a. Petals connate at base; Cameroon . . . . . *U. zenkeri* Engler
    4b. Petals separate at base.
      5a. Leaf blade 5.5–16.1 cm long; petals ovate, 5–11 mm long; Angola, Cameroon, Democratic Republic of Congo, Kenya, Sudan, Uganda, Zambia . . . . . *U. congensis* Robyns & Ghesquière
      5b. Leaf blade 12–23 cm long; petals suborbicular, 9–12 mm long; Ghana, Liberia . . . . . *U. globiflora* Keay
1b. Staminate (or hermaphrodite) and pistillate inflorescences all truncifloroous.
  6a. Flowers sessile or very shortly pedicellate; Cameroon . . . . . *U. sessiliflora* (Mildbraed & Diels) Robyns & Ghesquière
  6b. Flowers distinctly pedicellate.
    7a. Petals connate at base.
      8a. Flower buds ovoid-conic to pyramidal.
        9a. Leaf blade 12–30 cm long; pedicel 10–45 cm long; petals 3, broadly ovate; Cameroon, Democratic Republic of Congo, Gabon . . . . . *U. congolana* (De Wildeman) R. E. Fries
        9b. Leaf blade 16–52 cm long; pedicel 1.5–8.0 cm long; petals 4, lanceolate to ovate.

10a. Leaf blade 30–52 × 9–14 cm; inflorescences mostly borne at base of trunk; sepals 2–5 mm long; petals 10–35 × 5–12 mm; Cameroon . . . . . *U. korupensis* Gereau & Kenfack

10b. Leaf blade 16–38 × 5–11 cm; inflorescences densely covering trunk from base to 2 m or more above ground; sepals 5–10 mm long; petals 15–18 × 5–8 mm; Cameroon . . . . . *U. submontana* Kenfack, Gosline & Gereau

8b. Flower buds globose.

11a. Staminate flower with petals 18–20 mm long; Côte d'Ivoire, Guinea-Konakry, Liberia, Sierra Leone . . . . . *U. guineensis* Keay

11b. Staminate flower with petals 10–13 mm long; Cameroon, Democratic Republic of Congo, Gabon . . . . . *U. vanderystii* Robyns & Ghesquière

7b. Petals separate at base.

12a. Petals ovate or elliptic-ovate, obtuse or acute.

13a. Leaf blade 12–20 cm long; staminate flower with petals 8–13 × 4.5–7.0 mm; pistillate flower with pedicel to 18 cm long and petals to 25 × 15 mm; Cameroon, Nigeria . . . . . *U. dioica* (Diels) Robyns & Ghesquière

13b. Leaf blade 19–29 cm long; staminate flower with petals 7–8 × 3–5 mm; pistillate flower with pedicel 4.5–11.0 cm long and petals 8–9 × ca. 5 mm; Gabon . . . . . *U. letestui* Pellegrin

12b. Petals linear-lanceolate to oblong-lanceolate or ovate-lanceolate, acute to acuminate.

14a. Petals linear-lanceolate; Cameroon, Nigeria . . . . . *U. bakeriana* (Hutchinson & Dalziel) Robyns & Ghesquière

14b. Petals oblong-lanceolate or ovate-lanceolate.

15a. Leaf blade narrowly elliptic or oblanceolate, 11–20 × 4–6 cm; staminate flower with pedicel ca. 0.4 cm long; pistillate flower with pedicel ca. 7 cm long and petals 14–15 × ca. 7.8 mm; Angola . . . . . *U. noldeae* Exell & Mendonça

15b. Leaf blade obovate-oblong, 16.6–29.0 × 5.0–9.5 cm; staminate flower with pedicel 1.5–1.7 cm long; pistillate flower with pedicel 8–16 cm long and petals 15–23 × 4.5–7.0 cm; Cameroon, Central African Republic, Congo Republic, Democratic Republic of Congo, Gabon . . . . . *U. solheidii* (De Wildeman) Robyns & Ghesquière

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Hemipiliopsis, a New Genus of Orchidaceae

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ABSTRACT. *Hemipiliopsis*, a monotypic new genus of Orchidaceae, is described based on *H. purpureopunctata* (K. Y. Lang) Y. B. Luo & S. C. Chen (*Habenaria purpureopunctata* K. Y. Lang) from southeastern Xizang (Tibet). Its possible relationships to *Brachycorythis*, *Hemipilia*, and *Habenaria* are discussed.

Key words: China, *Hemipiliopsis*, Orchidaceae.

While the senior author worked on the genus *Hemipilia* Lindley, he felt it difficult to treat a species that is very similar in habit to *Hemipilia* but was described by Lang (Lang & Tsi, 1978) as *Habenaria purpureopunctata* K. Y. Lang. Moreover, Lang mentioned that this generic placement was based on the presence of a small rostellum, naked viscidia, and two protruding clavate stigmas (Lang & Tsi, 1978). Based on these floral features, this species appeared to be allied with *Habenaria* Willdenow, while its purple-spotted stem, leaf, and other parts, as well as a large-mouthed spur with a globular-swelled tip indicate its close relationships to *Hemipilia*. Two years later, Lang (1980) stated that *Habenaria purpureopunctata* is intermediate between *Habenaria* and *Hemipilia*.

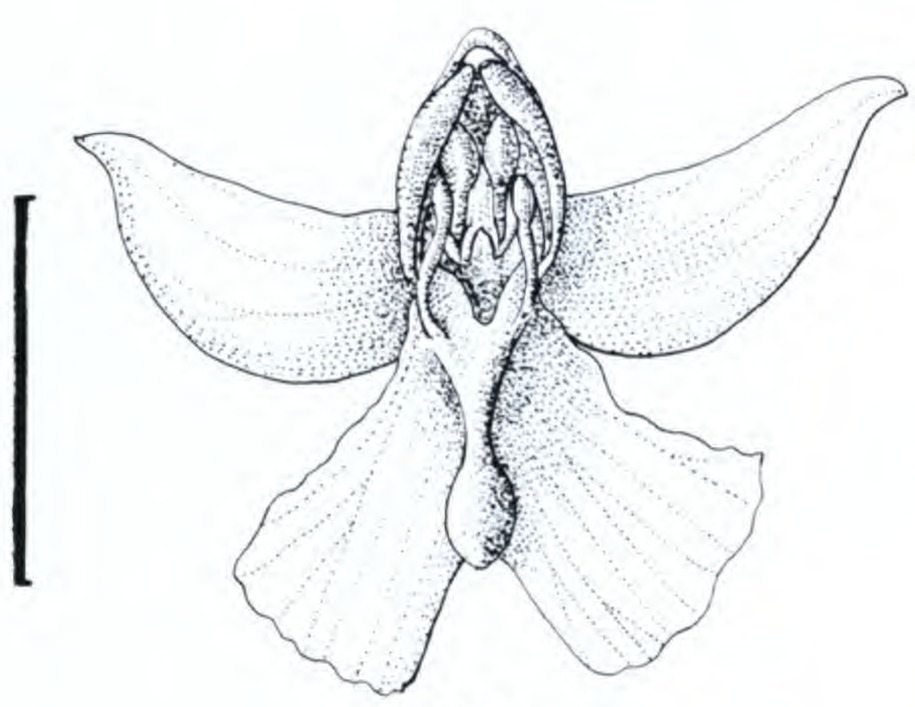
During a trip of the senior author to southeastern Xizang (Tibet) in 1996, several plants of this species were collected and later transplanted to our greenhouse. They flowered the next year, so we had the opportunity to investigate its floral morphology and ontogeny. As a result, *Habenaria purpureopunctata* was tentatively proposed as a new genus of Orchidiinae s. str. (sensu Dressler, 1993) rather than a member of Habernariinae (sensu Dressler, 1993; Luo et al., in prep.). Moreover, the nuclear ribosomal DNA internal transcribed spacers (ITS) data supported the placement of *Habenaria purpureopunctata* in the subtribe Orchidiinae s. str. (sensu Dressler, 1993; Bateman et al., 2001). It is treated here as a separate new genus differing from both *Habenaria* and *Hemipilia*.

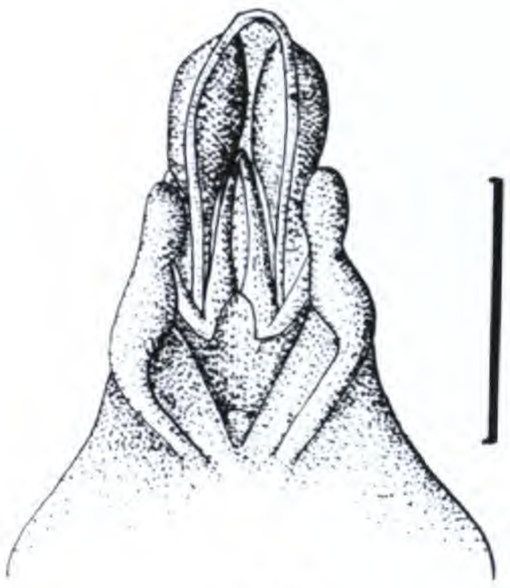
Hemipiliopsis Y. B. Luo & S. C. Chen, gen. nov. TYPE: *Hemipiliopsis purpureopunctata* (K. Y. Lang) Y. B. Luo & S. C. Chen.

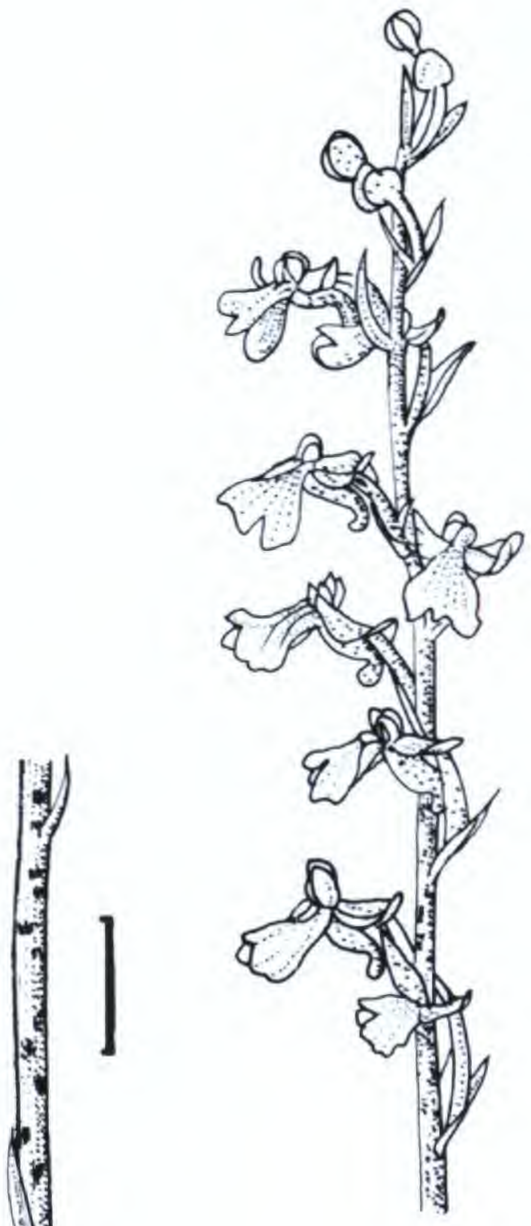
Hoc genus novum *Hemipiliae* et *Habenariae* simile, sed ab ambobus forma calcaris, a priore viscidiis plus minusve expositis, stigmatis lobulis duobus elongato-pulvinatis, a posteriore planta (cum caule, folio, pedunculis, rachidi, bracteis, pedicellis, ovariis, sepalis et petalis) purpureopunctata, stigmatis lobulis parieti postico cavitatis affixis, atque rostello magno differt.

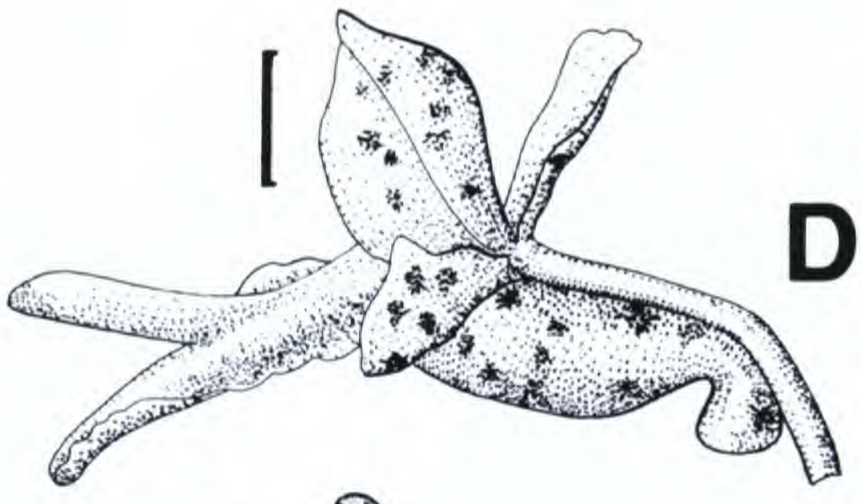
Terrestrial herb; tubers ellipsoid or subellipsoid, fleshy. Stem erect, usually with one leaf near the base. Leaf elliptic to ovate-oblong, acuminate or acute, amplexicaul at base. Inflorescence loosely several- to many-flowered, spotted with purple on rachis and peduncle; bracts ovate-lanceolate, with evident purple spots dorsally; pedicel and ovary with purple spots. Flowers spotted with purple except the lip; dorsal sepal erect, oblong, concave, forming a hood together with petals; lateral sepals obliquely ovate-elliptic, usually ± reflexed; petals ovate-orbicular; lip subobovate or ± fan-shaped, 3-lobed at apex, the lobes nearly oblong, the lateral lobes broader than the central one, spur abruptly contracted in basal part and then strongly expanded to form a globose apex; anthers sessile, erect, with two parallel thecae; lateral gynostemium appendages obvious and positioned next to anther; rostellum three-lobed, with two separate lateral lobes bearing naked viscidia at apex, the lateral lobes extending forward, but not along walls of cavity and their apices completely separate, the viscidia positioned directly above spur mouth; the extended, two-folded central lobe approximately half as long as anther; fertile stigma situated in a cavity and consisting of two elongated pads adnate to its posterior wall, positioned below rostellum and directly above spur mouth; pollinia sectile, fragile, each proximally attenuated into a caudicle attached to viscidium.

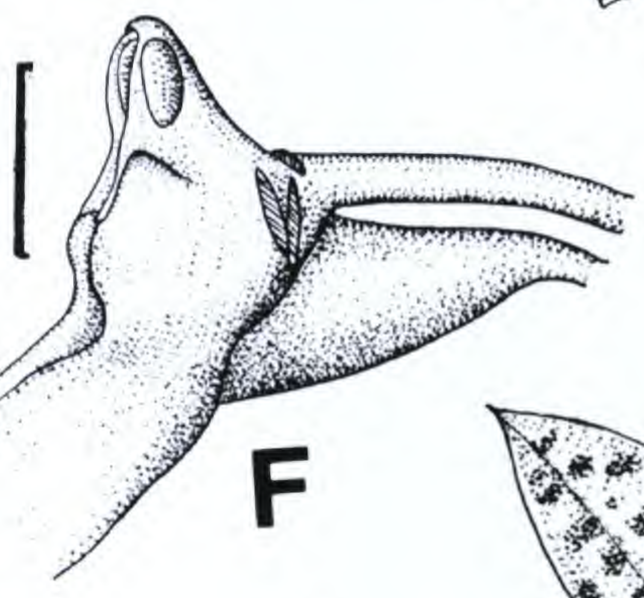
Hemipiliopsis purpureopunctata (K. Y. Lang) Y. B. Luo & S. C. Chen, comb. nov. Basionym: *Habenaria purpureopunctata* K. Y. Lang, Acta Phytotax. Sin. 16(4): 127, fig. 2. 1978. TYPE: China. SE Xizang (Tibet): Bomi, 2500 m, 19 July 1965, *Y. T. Chang & K. Y. Lang 384* (holotype, PE). Figure 1.

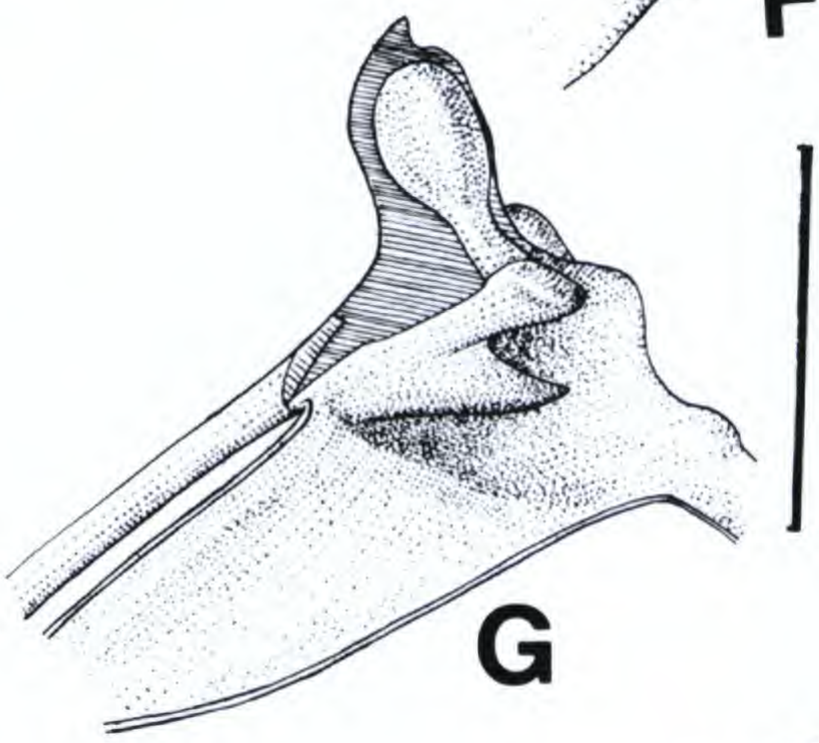


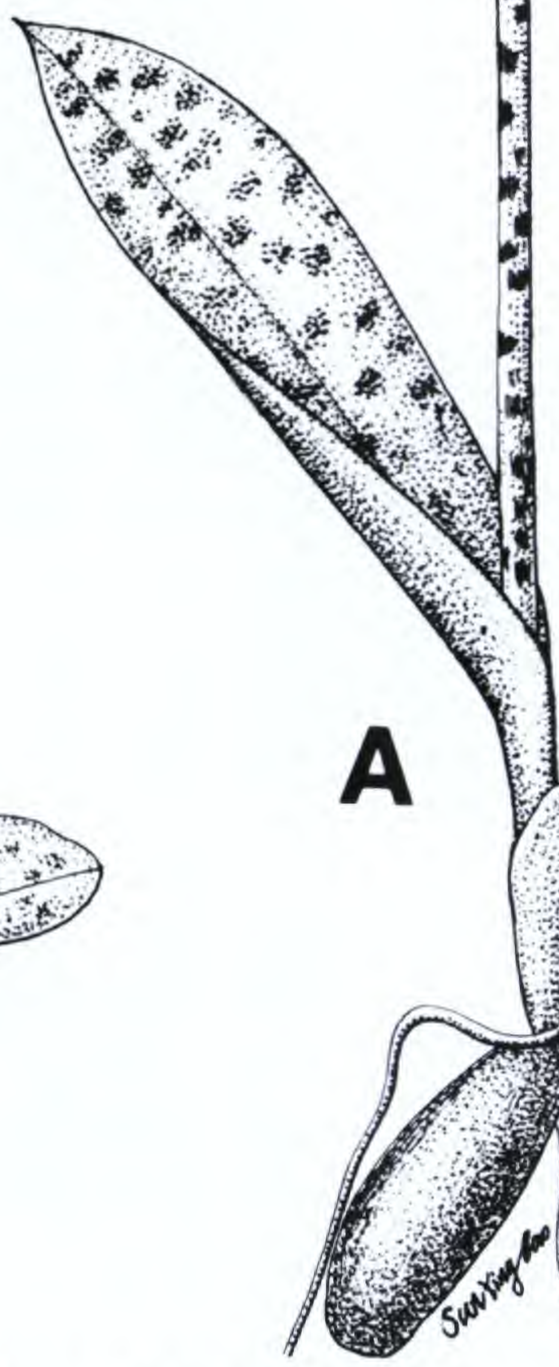












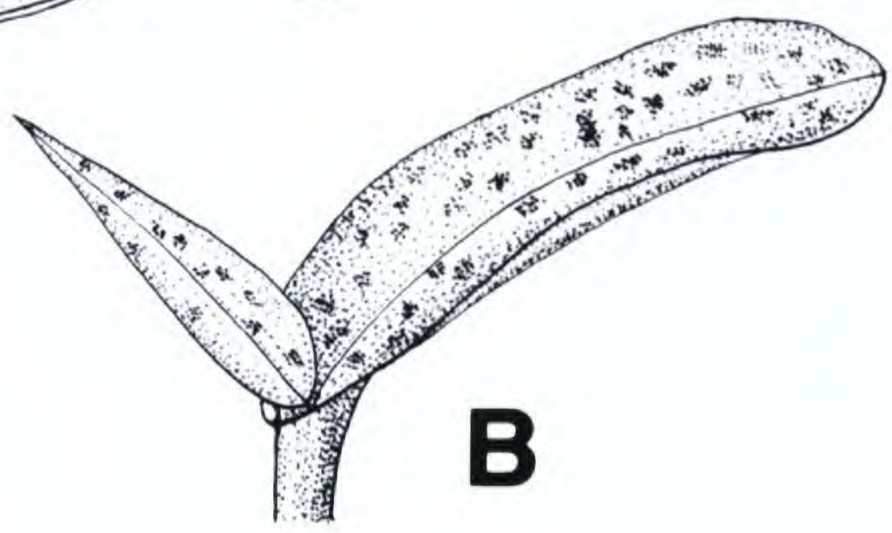


Figure 1. *Hemipiliopsis purpureopunctata* (K. Y. Lang) Y. B. Luo & S. C. Chen. —A. Plant. —B. Plant with two leaves. —C. Flower, front view. —D. Flower, lateral view. —E. Column, front view. —F. Column, lateral view. —G. Longitudinal section of column. —H. Pollinium with viscidium, vertical view. —I. Pollinium with viscidium, lateral view. Scale bar: A–C = 1 cm; E = 0.5 mm; D, F, G = 1 mm; H, I = 0.25 mm. Drawn from specimen of *Y. B. Luo 14* in cultivation.

Plant covered with purple spots throughout, 20–50 cm tall; tubers 2–4 × 1.5–2.0 cm; stem, usually with 2 to 5 sterile bracts above the leaf. Leaf slanting upward, 5–15 × 2–5 cm, green with purple spots above, light purple beneath. Inflorescence 8–20 cm long, loosely 2- to 20-flowered; bracts usually shorter than ovary; pedicel and ovary 13–15 mm long, with purple spots. Flowers light purple or white purple; dorsal sepal ca. 5 × 2 mm, rounded or obtuse, 3-nerved; lateral sepals, ca. 6 × 4 mm, obtuse, 3-nerved; petals ca. 5 × 4 mm, obtuse, 3-nerved; lip 10–11 mm long, 9–10 mm wide in upper part, 3-lobed at apex, the lobes irregularly undulate along apical margins; spur 9–10 mm long, 2–3 mm thick, contracted at a distance of ca. 1.5 mm from spur mouth, the globose apex ca. 2–3 mm diam. Capsule ellipsoid, with purple spots, 15 mm long, 2–3 mm diam. Flowering: June to July; fruiting: August to September.

This species is distributed in Nyingch, Lhünze, Mainling, Bomi, and Zayu, southeastern Xizang, China, between 2100 and 3400 m, growing in broad-leaved evergreen forest, alpine oak forest, grassy places, and sandy soil along rivers. It also occurs in Assam.

In habit *Hemipiliopsis* is similar to *Hemipilia* (Lang & Tsi, 1978; Lang, 1980; Lang, 1999), but differs from the latter by being covered with purple spots throughout (Chen et al., 1999).

As to its floral morphology, *Hemipiliopsis* has pad-like stigmas adnate to the walls of the cavity, a typical feature in the subtribe Orchidinae (Kurzweil, 1987; Kurzweil & Weber, 1991; Luo & Chen, 2000). It also lacks some typical features of *Habenaria*, such as obvious anther canals and strongly convex or stalked stigmas (Kurzweil & Weber, 1992; Luo et al., in prep.). Therefore, the floral morphological evidence does not support a close relationship between *Hemipiliopsis* and *Habenaria*. On the other hand, this species is quite different from *Hemipilia* in many floral features. For example, the genus *Hemipilia* is characterized by (1) a well-developed three-lobed rostellum with the central lobe conspicuously projecting upward as high as or higher than the anther; (2) lateral lobes of the rostellum being completely separate and extending along the walls of the cavity, forming a shallow channel together with the prominently extended basal parts of the lateral gynostemium appendages in which the anther caudicle is positioned; and (3) the viscidia being positioned on the inner sides of the wall of the cavity (Luo & Chen, 1999, 2000). In *Hemipiliopsis*, however, the three-lobed rostellum does not have well-developed lobes, the lateral lobes extend straight forward but not along the walls of the cavity, and the viscidia are positioned directly above the spur mouth (Luo et al., in prep.).

The rostellum structure of *Hemipiliopsis* is similar to that of *Brachycorythis* Lindley (Kurzweil & Weber, 1991), especially that of *B. tanganyikensis* Summerhayes (Cribb, 2001). The lateral rostellum lobes of *Brachycorythis* are adjacent at their apexes as illustrated by Kurzweil and Weber (1991, figs. 1, 2) except in *B. tanganyikensis*, where they are obviously separated at their apexes as shown by Cribb (2001, fig. 65.1). However, the lateral rostellum lobes of *Hemipiliopsis* are completely separated at their apexes. In addition, *Brachycorythis* has many cauline leaves, foliaceous bracts, and a bipartite lip, by which it is clearly differentiated from *Hemipiliopsis*.

As demonstrated above, this entity has so many distinct features, both in vegetative and floral characters, as compared with other members of the tribe Orchideae (sensu Dressler, 1993) that it is reasonable to treat it as a new genus. Based on its floral morphology, especially the rostellum structure, it seems more closely related to *Brachycorythis* than to *Hemipilia*.

Specimens examined. CHINA. **Xizang:** Ma Gu Dong, hillside, *P. C. Tsoong 6685* (PE); Bomi, grassy slope, *Y. T. Chang & K. Y. Lang 828* (PE); forested valley, 2050 m, *collector unknown 1522* (KUN, PE), *Wu Chen-Yih 5638* (KUN); 2100 m, *Xiao Pei-Gen et al. 2256* (KUN); 2300 m, conifer & oak forest, *F. Ludlow, G. Sherriff & H. H. Ellitot 13194* (BM), *F. Ludlow, G. Sherriff & H. H. Ellitot 15814* (BM); Nyingch, grassy place in forest, 2300–2700 m, *Medicinal Plant Collecting Team (Xizang) 3422* (PE); forested slope, 2700–2800 m, *Medicinal Plant Collecting Team (Xizang) 3539* (PE); under shrubs on sandy banks of a river, 2550 m, *Y. B. Luo 14* (MO, PE); 3000 m, *H. N. Qing et al. 533* (PE); Mainling, alpine oak forest, 3300–3400 m, *collector unknown 4145* (PE); *Additional Collecting Expedition to Qinghai-Xizang 750836* (KUN, PE); Lhünze, 2740 m, *Additional Collecting Expedition to Qinghai-Xizang 750564* (KUN, PE); Lung, Chanyul Chu, open dry hillside, 3000–3300 m, *F. Ludlow & G. Sherriff 2324* (K).

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Passiflora boenderi (Passifloraceae), a New Egg-Mimic Passionflower from Costa Rica

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ABSTRACT. *Passiflora boenderi*, a new species of Passifloraceae endemic to Costa Rica, is described and illustrated. It is assigned to section *Decaloba* DC. in the species group that includes *P. gilbertiana* J. M. MacDougal and *P. ornithoura* Masters. This rare small-flowered species is notable for its intensely colorful and variegated leaves, with rows of conspicuous golden egg mimics.

Key words: Costa Rica, egg mimic, *Passiflora*, Passifloraceae.

For more than a century, a collection of a Costa Rican passionflower with bilobed purple-tinged leaves with yellow stripes and dots has hidden in herbaria under different names. Only after plants of this taxon were collected alive and then cultivated have we been able to study the fresh flowers and see that it is an undescribed species, perfectly morphologically distinct. While close relatives in section *Decaloba* have similar variegated leaves, this new species is most dramatic, with leaves dark green above and purple or red-purple beneath, with light yellow stripes along the two major lateral veins and conspicuous bright golden spots in two lines. It is a choice plant for ornamental cultivation for its foliage, but is a local endemic in primary rain forest in central Costa Rica and is of conservation concern.

Passiflora boenderi J. M. MacDougal, sp. nov. TYPE: U.S.A. Florida: Broward Co., Coconut Creek, cultivated at Butterfly World, Ltd., 1992–2002, type specimens collected Nov. 2001, *R. Boender 361*, grown from plants collected 19 May 1992 in Costa Rica. Alajuela: W of main road San Ramón to Bajo Rodríguez, between Río Cataratas and Río San Lorenzo on side rd. to Colonia Palmareña, "near dead volcano," ca. 1 km N of Finca Santa Cecilia, 10°13′43″N, 84°33′34″W, 800 m (holotype, CR; isotypes, BM, CAS, INB, GOET, K, MEXU, MO, TEX). Figures 1, 2.

Species scandens ad *Passifloram* sectionem *Decalobam* pertinens. Folia petiolo eglanduloso; lamina supra vittata, infra purpurata vel atrovinosa, biloba; lobis lateralibus acutis vel acuminatis, interdum rotundatis, lobo centrali obsoleto, angulo inter lobos laterales 14–62°, marginibus integris, nectariis aureis. Flos parvus, petalis 3–6 mm longis; coronae filamentis biseriatis, exterioribus luteolis 3.5–5.5 mm longis; operculo plicato; androgynophoro 2.9–4 mm longo; semina (7 vel) 8 ad 10-sulcata.

Vine 1.5–5 m, minutely puberulent throughout at the cernuous shoot tip, glabrescent below; stems ± terete, striate. Stipules 1.7–3.5 × 0.2–0.3 mm, linear-triangular, subfalcate; petioles 1.2–3.8 cm, eglandular; leaf blades 4–12(–17) cm long in outline, 4.0–8.0(–9.5) cm wide, 2.4–7(–9.0) cm along central vein, lateral veins 4.0–8(–9.2) cm, entire, glabrous or glabrescent except margins minutely lightly strigillose and sometimes with a few trichomes on the larger veins abaxially, variegated adaxially with light yellow along the three major veins, especially on lateral lobes, (often deep) purple or red-purple abaxially, truncate elliptic to obovate to widely obovate (to very widely obovate) in general outline, bilobed ⅖–½(–⅐) their length, the lateral lobes triangular to lanceolate, acute to acuminate, the very apex sometimes rounded, the central lobe absent or nearly so, sometimes represented by a mucronate cusp less than 5 mm long, the angle between the lateral lobes (14–)23–50(–62)° (juvenile plants with leaves less deeply lobed), the ratio of lateral to central lobe length 1.7–2.3(–2.5); laminar nectaries (5 to)8 to 13(to 16), borne between the main veins, appearing bright yellow or yellow-orange adaxially, and yellow-orange with purple border abaxially, the larger leaves often with a single nectary proximal (exmedial) to each lateral vein at base of lamina; prophyll of vegetative bud 1, lanceolate to narrowly triangular. Peduncles (1)2 per node, 1–3 cm, uniflorous; bracts 3, 1–2.8 × 0.1–0.15 mm, linear-triangular, usually early necrotic and stramineous. Flowers light yellow-green, the corona yellowish with purple or purple-red basally and/or distally; flowers with little or no detectable odor, borne sub-horizontally at anthesis; floral stipe (3.5–)4.0–7.0 mm (6.5–9 mm in fruit); hypanthium 5.5–7 mm diam.; sepals 7.0–11(–14) × 3.0–5.0 mm, triangular-oblong to narrowly ovate-

Figure 1. Leaves of *Passiflora boenderi* (clone of type material, *Boender 361*). Egg-mimic laminar nectaries can be seen as round light spots on the leaves.

Figure 2. Flower of *Passiflora boenderi* with inner coronal series well expressed (clone of type material, *Boender 361*).

triangular, obtuse to rounded, with no apical or subapical horn, light yellow-green outside, slightly paler light yellow-green or green-yellow inside, at anthesis reflexed (to wrapped under hypanthium); petals (2.7–)3.0–6.0 × 2.0–3.0 mm, triangular-oblong to broadly triangular-oblong, broadly obtuse, strongly reflexed at anthesis, sometimes erose apically, very pale green (green-white) to pale yellow-green; coronal filaments 2-seriate, the outer coronal filaments (31 to)35 to 43 (samples N = 10), 3.5–5.5 mm long, at base narrow and greenish suffused with light purple or red-purple, or dull purple whole proximal half, conspicuously geniculate near middle, conspicuously thicker and dull to light yellow in middle or distal half, sometimes also purple or purple-brown distally, but always with yellow or pale yellow at least in middle, at anthesis the outer corona forming a shallow bowl or saucer with a strongly spreading and reflexed edge, the filament tips pointing downward, the anther-corona clearance 2.5–3.5 mm; inner coronal series inconspicuous, few to many, ca. 7 to 39 per flower, 1.0–1.8 mm, capillary, clavate to capitellate, dull light purplish with yellow head; operculum 2.0 mm, plicate, pale greenish, flushed pale violet or red-purple below the white apex; androgynophore 2.9–4.0 mm long, pale green basally, suffused purplish or red-purple proximally, the free portions of the staminal filaments 2.6–3.5 mm long, red-purple or green suffused with pale purple; anthers 2.0–2.3 mm long, purple-edged, the pollen yellow; ovary 1.5–2.0 × 1.3–1.5 mm, widely (to very widely) ellipsoid, bright green, minutely puberulent in all specimens seen except one where the ovary is glabrous (*Endres 70*); styles 4–5 mm long including stigmas, green and unmarked, or with a faint overall flush of purple, the stigmas 1.5–2 mm diam. Fruit 11–21 × 10–20 mm, (ellipsoid) widely ellipsoid to subglobose, estipitate, purple-black with glaucous bloom, the mesocarp light green to white; arils 7–8 mm long, transparent white to very pale transparent orange, gelatinous, sweet, not or only slightly fruity, nearly odorless; seeds 3.5–4.2 × (2.4–)2.7–3.0 × 1.4–1.7 mm, transversely sulcate with (7)8 to 10 sulci, the intervening ridges strongly sculptured and verrucose, the funiculus conspicuous and white on fresh seed; seeds per fruit 24 to 67 (N = 10); germination epigeal.

Ecology. *Passiflora boenderi* is known from only two sites in the Caribbean drainage of central Costa Rica at 725–800 m elevation. These are nearly identical habitats at the elevational transition of very wet to pluvial premontane forest. At both sites nearly all trees and branches are festooned with bryophytes, and the ground is often saturated and muddy. The vines are found growing up and into small trees on steep slopes, and on large shrubs at forest edges. Narrowly endemic species such as this passionflower, restricted to very small ranges, are typically in danger of extirpation by habitat conversion, and are therefore of special conservation concern. At the field site of the collection of the type clones, *P. boenderi* was associated with or near *P. ambigua* Hemsley, *P. lobata* (Killip) J. M. MacDougal, *P. guatemalensis* S. Watson, *P. costaricensis* Killip, *P. vitifolia* Kunth, and *P. oerstedii* Masters (R. Boender, pers. comm.). At the Cariblanco site I found *P. capsularis* L. and *P. lobata*.

Phenology. Flowering plants have been collected in January, April, and August through November.

This new species was first collected more than 125 years ago by A. R. Endres and was cited by Hemsley (1880: 481) as "*Passiflora, sp.* (*P. capsularis* [L.] *aff.*)." The specimens are without exact locality. One of Endres's known collecting sites is Quebrada Verde near San Ramón, very close to the type locality. We now know it from two localities, but it is rare at both. Larry Gilbert's 1978 collection was the second discovery of the species, and was brought into cultivation for a short while but perished before studies could be made of it. Despite repeated searches by botanists, the species was not found again until 1984. In 1991 Andrés Vega found it near San Ramón, took cuttings, and reared the butterfly *Heliconius cydno* from eggs and larvae on the plant. He guided Ron Boender there the next

year and assisted getting more living material, some of which ultimately furnished the type specimens. Clones of the type collection of *P. boenderi* were introduced to horticulture in late 1992 and had spread to Europe by 1995. The collection number of the type clones has been cited variously as *Boender 361*, *BW361*, and *BW92-361*. Several recent popular books on passionflowers have included this species under a nomen nudum, and color photographs can be seen in Vanderplank (1996: 61; 2000: 60–61), Klock (1996: 105–106), and Ulmer and Ulmer (1997: 110).

Passiflora boenderi is assigned to subgenus *Decaloba* (DC.) Reichenbach sect. *Decaloba* DC. on the basis of its plicate operculum, cernuous shoot tips, transverse testal sculpturing, and position of laminar nectaries. It is part of the species group that includes *P. ornithoura*, *P. gilbertiana*, *P. apetala* Killip, *P. jorullensis* HBK, *P. mexicana* Jussieu, and *P. affinis* Engelmann. Most similar is an undescribed relative of *P. ornithoura* from the mountains of Chiapas and Guatemala represented by *Matuda 3971*. That can have remarkably similar leaves, but *P. boenderi* differs by its longer outer corona (3.5–5.5 mm vs. 1.8–3 mm), a slightly shorter androgynophore (2.9–4.0 mm vs. 3.4–4.9 mm), and a usually pubescent ovary versus an always glabrous ovary. The bilobed variegated leaves of *P. boenderi* can be similar also to *P. gilbertiana* and *P. apetala*, which both grow in Costa Rica. *Passiflora boenderi* can be distinguished from *P. gilbertiana* by its shorter androgynophore (3–4 mm vs. 6.2–9 mm), its shorter outer corona (3.5–5.5 mm vs. 5–7 mm) that is strongly dilated proximally (vs. filiform), and its habitat (elevations of 725–800 m vs. 1600–2300 m). From *P. apetala* it may be recognized by its often longer outer corona (3.5–5.5 mm vs. 2–5 mm) that is strongly dilated proximally (vs. filiform), its longer petals (2.7–6 mm vs. absent or to 2.5 mm), a usually pubescent ovary vs. always glabrous ovary, and its habitat (elevations of 725–800 m vs. 1280–3270 m). The angles between the leaves' lateral lobes are usually wider in *P. apetala* and narrower in *P. gilbertiana*, but there is overlap.

The inner corona was variably expressed in the flowers of the six individuals I examined closely, varying from 7 to almost 40. This is similar to the variable expression of the inner corona in its very close relative, *P. gilbertiana*, where their number can vary greatly even on one plant (MacDougal, 1989). The conspicuous bright golden laminar nectaries closely resemble *Heliconius* butterfly eggs (Gilbert, 1982), and I consider this species to have one of the most conspicuous cases of egg-mimicry known (pers. obs.).

Fruit and aril observations were made by the author from ten fresh fruits produced in cultivation by Ron Boender through manual cross-pollination of several individuals of the type material.

Etymology. This species is named for Ronald Boender, founder of the Passiflora Society International, and also president for many years. As prime mover of that society, since 1989 Ron has brought together several hundreds of persons interested in the genus *Passiflora*, both amateurs and professionals. He established a seed bank, living collections database, newsletter, and annual national and international meetings. In this way, he has set the foundation for a forum that has truly benefited science and the diffusion of knowledge of this plant group. In Coconut Creek, Florida, he maintains the world's largest collection of germplasm of Passifloraceae. Additionally, Ron brought this new species into horticulture for closer study, unselfishly spread it widely, and hounded me for more than a year with carefully collected evidence that it was new. Through his studies and educational presentation of both butterflies and their host plants, he continues to champion and support numerous conservation activities in North, Central, and South America.

Paratypes. COSTA RICA. Locality unknown: 2500 ft., "Costa Rica," [anno 1867–1875], *Endres 70* (BM, K). **Alajuela:** along Río Sarapiquí near La Virgen de Socorro near Cariblanco, Apr. 1978, *L. E. Gilbert s.n.* (TEX); camino Colonia Virgen del Socorro, Cariblanco de Sarapiquí, 4 Jan. 2000, *Kay & Vega 196* (MO); cuttings of *Boender 361* from Costa Rica cultivated 1992–2002 at MO Climatron® greenhouse, 8 Sep. 1993, *MacDougal 4697* (CR, MO); rd. to La Virgen de Socorro from Rte. 9, near small cascade along the rd. on E side of the Río Sarapiquí, ca. 10°15.4′N, 84°10.3′W, 29 Aug. 1994, *D. Smith 1186* (DUKE); Sarapiquí, Cariblanco, camino a Virgen del Socorro, 8 Oct. 1992, *A. Vega s.n.* (CR, USJ).

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A New Section of *Passiflora*, Subgenus *Decaloba* (Passifloraceae), from Central America, with Two New Species

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ABSTRACT. The new section *Pterosperma* in *Passiflora* subg. *Decaloba* (Passifloraceae) is described from southern Mexico and Central America on the basis of leaf, inflorescence, seed, and fruit morphology. Species in this section are the sole hosts of the specialized herbivore *Eueides lineata* (Heliconidae). A morphological key to its four species is given, and two species, *Passiflora lancetillensis* and *P. pedicellaris*, are newly described and illustrated.

Key words: Central America, *Eueides*, Mexico, *Passiflora*, Passifloraceae, *Pterosperma*.

Exploration of the lowland wet forests of southern Mexico and Central America has revealed the existence of a group of four closely related species of passionflower vines. When the first species to be named was grown and studied by L. Gilbert, it was obvious from the co-occurrence of the numerous petiolar nectaries with the stalked, relatively unspecialized inflorescence structure that the species did not fit into any known sections of the genus *Passiflora* L., and would not key out to any of the subgenera in Killip's monograph (1938). This unique group of large woody vines, distinguished by morphological characters and a shared specialized herbivore, is best recognized as a separate section of the genus and placed in subgenus *Decaloba* (DC.) Reichenbach. This subgenus is characterized by a plicate membranous floral operculum, variegation on juvenile leaves, and laminar nectaries not marginal. Two of the four species are newly described here; the other two recently have been described with detailed ecological observations (Gilbert & MacDougal, 2000; Knapp & Mallet, 1984).

Passiflora L. subg. **Decaloba** (DC.) Reichenbach sect. **Pterosperma** L. Gilbert & J. M. MacDougal, sect. nov. TYPE: *Passiflora microstipula* L. Gilbert & J. MacDougal.

Plantae scandentes ramulis juvenis apice cernuis. Folia stipulis minutis caducis; petiolo nectariis (0 vel) 1 ad 11 munito; lamina elobata, integra. Inflorescentia ex floribus uno ad sex sicut capreolo uno pedunculo portatis constans; pedicello bracteis tribus 0.8–3.5 mm longis praedito. Flos corona 2- ad 4-seriata; operculo plicato. Seminibus amplis, complanatis, reticulatis, marginibus 4-alatis.

Medium-sized woody vines to canopy lianas; stem and abaxial surface of leaves puberulent as seedlings, erect trichomes sometimes glandular, lightly puberulent to glabrous at maturity; stems terete, pith chambered, posture of shoot tip cernuous; stipules extremely reduced, caducous; petioles (0)1- to 11-glandular; laminas narrowly ovate to (very) widely ovate (conspicuously peltate in one species) with conduplicate ptyxis, entire, acute to abruptly acuminate (rarely obtuse), variegated adaxially or not in juveniles, usually glaucous abaxially, laminar nectaries present submarginally, or absent; prophylls of vegetative bud 2, collateral; tendrils in seedlings distally swollen and adhesive in at least one species; peduncle 1 per node, bearing both a tendril and 1 or 2 pedicels, these often branched so that the inflorescence is (1)2- to 6-flowered, the tendril expressed in the inflorescence sometimes aborting, the common peduncle sometimes reduced to nearly nothing so that the pedicels appear to arise from the leaf axils; bracts 3 per first order pedicel, 0.8–3.5 mm long, narrowly triangular to linear-lanceolate; floral stipe (pedicel distal to articulation) conspicuous, 9–42 mm long; flowers white with a yellow or white outer corona, this with a purplish red band or not; sepals and petals subequal, 17–25 mm long, coronal filaments in (2)3–4 series, the outermost 9–20 mm long, the inner 1.5–8 mm long; operculum plicate; androgynophore 7–14 mm; ovary puberulent to densely pubescent; fruit 4–6 cm diam., conspicuously stipitate, inflated, the pericarp very thin and leathery to parchment-like; seeds 6–12 × 5–11 mm, the testa retic-

ulate in center and surrounded by striate wings with erose to laciniate margins, the chalazal beak antiraphal; pollen 6-colporate; chromosome number n = 9 (one species known). Germination epigeal.

These four rather similar species are lianas of primary moist to wet tropical forest that form a cohesive and well-marked group here recognized as section *Pterosperma*. They flower in the canopy and thus are rarely seen or collected, and although considered to be uncommon to rare, they are sometimes locally common as sterile juveniles in light gaps (Gilbert, pers. obs.; Meerman, pers. comm.). Three of the four are known to be the sole host/food plant in their geographical area for the larvae of the uncommon heliconid butterfly, *Eueides lineata* (Mallet & Longino, 1982; Knapp & Mallet, 1984; Meerman, 1999). The stipules of each species are minute and deciduous, the new growth is cernuous, there are multiple petiolar nectaries, the minute laminar nectaries are submarginal when present, and the inflorescence type is very rare in the genus, i.e., a pedunculate dichasial cyme with the central pedicel modified to be a tendril. This is the type of inflorescence present in most of the other genera in the tribe Passifloreae. The white flowers have the characteristics of a bee-pollination syndrome, and indeed, one is known to be bee-pollinated (Meerman, pers. comm.). Each species has similar unusual marginally winged seeds, hence the name of the section. The arils and the shape, color, and persistence of the fruits are known for two of the four species of this section, and suggest dispersal by frugivorous bats (Gilbert & MacDougal, 2000). Leaves of *P. eueidipabulum* and *P. microstipula* were studied by Klucking, who published photographs of leaf clearings (1992: 239, pl. 88, fig. 4; 245–246, pl. 98, fig. 5).

This distinctive section is placed in *Passiflora* subg. *Decaloba* based on the presence of a plicate operculum, cernuous stem growth, and variegation along main veins of the leaf. Preliminary analysis of two genes also supports this placement (Hansen, in prep.). The new section is discordant in *Decaloba* by its multiple petiolar nectaries, 6-colporate pollen without secondary opercula (L. Escobar, pers. comm.), and the fundamentally cymose inflorescence. Though the stalked inflorescence type is like that of most other genera in the tribe Passifloreae, the placement of the bracts in the inflorescence is not. Here, as in most passifloras, the displacement of bracts onto the branches they normally subtend (the *recaulescence* of Cusset, 1968) has produced the evolutionarily derived state of 3-bracteate pedicels. Unpublished studies have found the chloroplast intron *rpoC1* to be present in *P. microstipula*, an evolutionarily basal state in the genus (Hansen, unpublished). The loss of this intron has occurred in some other species of subgenus *Decaloba*. Snow and MacDougal (1993) reported and illustrated the one chromosome count for this group, $2n = 18$ (from *P. microstipula* as "P. sp. nov. A"). The chromosomes were relatively small, more like those in the $2n = 12$ group, subgenus *Decaloba*, than in the subgenus *Passiflora*, in which $2n = 18$ is the norm. Thus, they concluded that the $2n = 18$ count is not homologous between this section and subgenus *Passiflora*.

KEY TO THE SPECIES OF *PASSIFLORA* SECTION *PTEROSPERMA*

1a. Leaves peltate 0.9–2.0 cm from the margin; floral stipe 9–15 mm (Costa Rica, Panama) . . . . . 4. *P. eueidipabulum*

1b. Leaves not peltate, or subpeltate 0.2–0.5 cm from the margin; floral stipe 16–42 mm (Mexico to Honduras).

2a. Leaves puberulent or pubescent abaxially at maturity; petioles 6–11-glandular; flowers with white or whitish outer corona (Belize, Honduras) . . . . . 1. *P. lancetillensis*

2b. Leaves glabrous abaxially, at least at maturity; petioles 1–10-glandular or glands absent; flowers with yellowish outer corona (Mexico, Guatemala).

3a. Petioles 1-glandular or glands absent; floral stipe 28–40 mm, pubescent; flower buds and sepals pubescent; flowers 1(2) per node (Guatemala) . . . . . 2. *P. pedicellaris*

3b. Petioles 4–8(–10)-glandular; floral stipe 16–26 mm, glabrous; flower buds and sepals glabrous; flowers 2 to 4 (to 6) per node (Mexico) . . . . . 3. *P. microstipula*

1. Passiflora lancetillensis J. M. MacDougal & J. Meerman, sp. nov. TYPE: Belize. Cayo: near San Ignacio, cultivated at the National Passionflower Collection of the Belize Tropical Forest Studies at Green Hills, *J. C. Meerman s.n.*, 9 June 1996, from several seedlings collected by Meerman on 2 Dec. 1994 in Belize, Cayo District, Tapir Mountain Nature Reserve, 17°09′N, 88°51′W, 100 m (holotype, BRH; isotypes, BM, GOET, MEXU, MO (2), TEX). Figures 1, 2, 3.

Haec species *Passiflorae microstipulae* similis, sed ab ea flore omnino albo filamentis coronalibus exterioribus filiformibus tortuosisque ornato, foliis latius ovatis ad nodos floriferos abaxialiter pubescentibus, sepalis pubescentibus atque nectariis petiolaribus plerumque multioribus distinguitur.

Large vine to low canopy liana, 9 m to at least 20 m, puberulent throughout with erect trichomes 0.3–0.6 mm long, these sometimes glandular, ex-

Figure 1. *Passiflora lancetillensis* J. M. MacDougal & J. Meerman. Flower and peduncle of clone of type material (*Meerman s.n.*). Note nectary glands on pubescent petiole at left. Photograph by Jan C. Meerman.

cept stem and adaxial surface of lamina glabrous at maturity; stems terete, 0.8–3 cm diam., with chambered pith, pubescent in younger plants, glabrous at maturity except pubescence persisting near nodes. Stipules minute to setaceous, 0.4–1.0 × 0.15–0.2 mm, deciduous; petioles 8- to 11-glandular, the nectaries 1.5–2.5 mm diam. in mature plants, obloid to depressed obovoid, (petioles 6–11-glandular in juvenile plants, the nectaries narrowly cylindrical, 0.3–1.0 × 0.1–0.3 mm); laminas (8)10–16(–22) × 7–15(–19) cm, not variegated (nor in seedlings seen, grown, or collected in Belize), widely ovate to very widely ovate, unlobed, not peltate, entire, abruptly acuminate to obtuse, often with submarginal laminar nectaries associated with the end of major secondary veins, sessile or short-cylindrical, borne 0.5–5 mm from margin; prophylls of vegetative bud 2, 0.6–1.5 mm long, widely to narrowly triangular, 3-toothed, collateral. Peduncle (common peduncle of tendril and flower) 1 per node, bearing both a tendril and 1 or 2 pedicels, 0–2(–3) cm long to the first branch, the pedicels 0.3–1.3 cm long, often 1- or 2-branched so that the inflorescence at the leaf axil is (1)2- to 4(to 6)-flowered, the tendril expressed in the inflorescence sometimes aborting, the common peduncle often reduced to nearly nothing so that the pedicels appear to arise from the leaf axils; bracts 0.8–2.0 × 0.2–0.5 mm, triangular to oblong-lanceolate. Flowers white with a whitish corona and light green center, borne upward; stipe 25–42 mm; sepals 18–23 × 6.0–9.0 mm, narrowly ovate-oblong, green abaxially, pale greenish yellow to white adaxially, with no projection; petals 19–22 × 7.0–8.5 mm, narrowly ovate-oblong, slightly narrowed at base, white; coronal filaments in 3 or 4 series, the outer 15–20 mm, filiform, tortuous in distal half, slightly attenuate toward tips, white or very pale cream, not banded, the inner 2 or 3 series 3.5–6 mm, filiform to capillary, straight, white; operculum 3.5–4.5 mm, membranous, plicate, green with white-fringed apex; limen floor apparently unmarked, androgynophore base not colored; androgynophore (8–)9–9.5 mm, light to pale green, in the type sparsely pubescent near the middle; staminal filaments free 6–8 mm, anthers 3.2–3.5 mm, not marked; ovary 3.7–4.5 × 2.7–3.5 mm, on a 1.5 mm gynophore, widely ellipsoid, densely pubescent; styles 9.5–11 mm in-

Figure 2. *Passiflora lancetillensis* J. MacDougal & J. Meerman. Two nodes along a stem, with associated leaves and peduncles. Interpretation of the structure of the inflorescence is aided by the letter "T" marking the tendrils. The articulations of the pedicels marking the floral stipes can be seen as darker lines on the pedicels. Scan by Jan C. Meerman of living plants of the type material (*Meerman s.n.*).

cluding stigmas, green and unmarked, usually lightly pubescent proximally. Fruit 6.5–8 cm long including 2.5–3.0 cm long stipe, 4.0–4.8 cm diam., widely ellipsoid or subglobose, slightly conical at attachment of stipe, blunt at apex, light green or yellowish green at maturity, inflated, indehiscent (but easily splitting into three parts with slight pressure), without strong odor, short-pubescent inside on placental walls with erect thick trichomes, exocarp very thin, leathery, drying parchment-like, ca. 1 mm thick; arils translucent whitish, insipid; seeds ca. 20 to 36 per fruit, 9.5–11.5 × 7.0–8.0 × 2 mm, dark brown, punctate-reticulate in center, the pits sometimes weakly organized into a few wavy rows, with 4 conspicuous marginal wings, (1.5–)2–2.5(–3.0) mm wide, striate, deeply erose to laciniate (to deeply laciniate at micropylar end), the chalazal beak antiraphal; germination epigeal.

Herbivory. The butterfly *Eueides lineata* (Nymphalidae: Heliconiinae) appears to be restricted to this species of vine in Belize. The females lay eggs singly on the underside of young but nearly fully expanded leaves and cause a distinctive feeding pattern of little windows in the leaf blade. The only other Heliconiinae butterfly utilizing this species is *Dione juno*, which is known to utilize a variety of passifloras as the larval food plant. *Passiflora lancetillensis* is rather toxic to *Dione*, however, and the larvae only rarely reach maturity (Meerman, pers. comm.).

Distribution and habitat. *Passiflora lancetillensis* is a low canopy-dwelling species of tropical evergreen or seasonal broadleaf lowland hill forest at elevations of 20–750 m where rainfall varies from 2000 to 4000 mm annually (Meerman & Sabido, 2001). In Belize, it is found in strongly karstic regions, with forest canopies at 20–35 m, and at least in some areas, with a marked dry season (Parker et al., 1993: 18). Because it has been found on the coast of Honduras and in extreme southwestern Be-

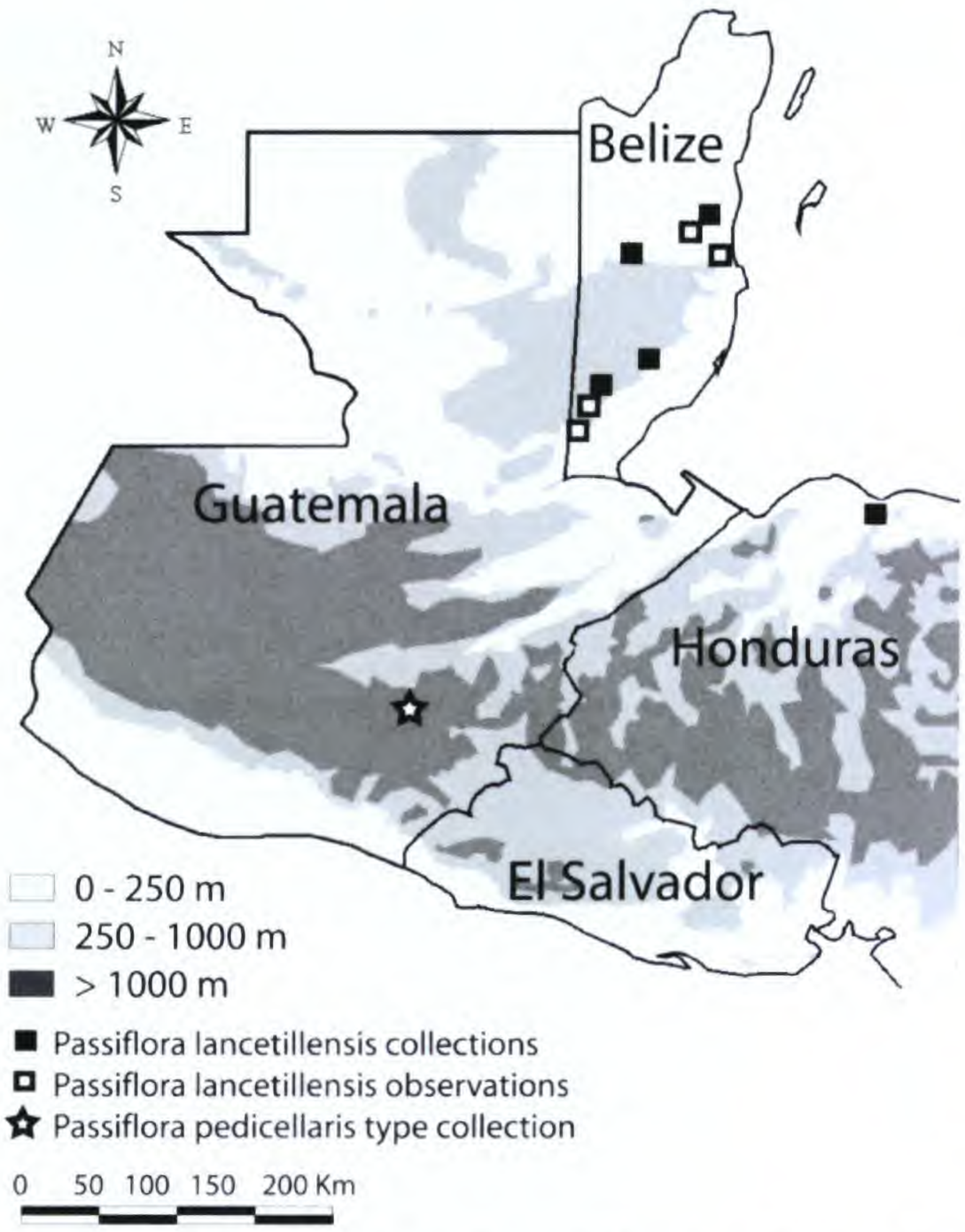

Figure 3. Map of northern Central America showing distributions of *Passiflora lancetillensis* and *P. pedicellaris*. Map courtesy of Jan C. Meerman.

lize, it might be expected in hilly forest patches in the intervening and neighboring departments of Izabal and Petén of Guatemala. Associated species of *Passiflora* include *P. obovata* Killip and *P. guatemalensis* S. Watson in southern Belize, and *P. mayarum* J. M. MacDougal in northern Belize.

This distinctive new species is presently known from five collection sites, one the Lancetilla Valley on the Atlantic coast of Honduras, and four from the hills of southern and central Belize. Additional localities where the species has been observed by Meerman, but not collected, are noted in Figure 3. The Honduran specimens, sterile and with large prereproductive leaves, were cited in the *Flora of the Lancetilla Valley* as a probable new species (Standley, 1931: 293, citing the monographer Killip).

The species is clearly closely related to, but distinct from, *Passiflora microstipula* and *P. eueidipabulum*. Large leaves at prereproductive nodes are non-peltate and evenly puberulent to pubescent beneath, and the petioles have significantly more glands. The stem is lightly puberulent. As in *P. microstipula*, there is a pronounced change of morphology of the petiolar glands from narrowly cylindrical in juvenile leaves to larger depressed obovoid glands in leaves on large plants or at reproductive nodes (Gilbert & MacDougal, 2000). Unlike *P. microstipula*, however, the leaves remain pubescent on the undersides at maturity, and the flower buds and longer floral stipes are pubescent. The flower is distinctive in the group, with an all-white filiform corona instead of stockier filaments that are laterally compressed and yellow or yellow with reddish purple bands.

Fruits are known from a few produced by open cross pollination of the type plants in cultivation, and from one fallen empty fruit of a canopy liana in the field (*Holst & Davidse 5459*). Seeds are known only from the cultivated type material. The seeds are similar to those of *Passiflora microstipula* and *P. eueidipabulum*, with the distinctive erose marginal wings found in all the species of the section, but the margins of the wings are cut more deeply, even laciniate to base at the micropylar end.

At the National Passionflower Collection of the Belize Tropical Forest Studies in Cayo District (240 m), the flowering season appears to be May through August. Flowers stand erect and open before dawn. On hot days, the flowers may wilt before noon, but mostly remain open all day, even into the evening on cooler days. Usually only one flower per peduncle opens each day. The flowers emit a strong and pleasant coumarin-like odor. Medium-small bees frequent the flowers in cultivation, with most activity ceasing in mid-morning around 10 a.m. (Meerman, pers. comm.). One of these visitors, a 1.0 cm long bee in the Anthophoridae, closely matched the functional size of the flowers and while foraging for nectar, appeared to carry pollen on its hairy thorax from flower to flower. The usual pollinators in wild habitat are probably bees of similar size. Hummingbirds have also been seen occasionally to visit the flowers (Meerman, pers. comm.).

Healthy F1 seedlings have been produced in the greenhouse by crossing between this new species and *Passiflora microstipula* (Gilbert & MacDougal, 2000), but these have not flowered yet.

This new passionflower was listed (as a nomen nudum, *P. lancetillensis* M[a]cDougal) in Parker et al. (1993: 10, 38, 51), and its associated vegetation was discussed. Jan Meerman introduced the species to horticulture by 1996, and briefly described and figured it in the Passiflora Society International's newsletter (Meerman, 1996). A color photograph and description in German soon appeared in a popular handbook on passionflowers (Ulmer & Ulmer, 1997). By 1998 it was listed in plant collections from at least four countries (Schappert, 1998: 23) and is now available from a few commercial plant dealers. The name also appeared in the 1997 version of the *IUCN Red Book* (Walter & Gillett, 1998: 446) where it was scheduled as R (Rare) from information provided by MacDougal.

The specific epithet refers to the Lancetilla Valley in northern Honduras where this species was first collected.

Paratypes. U.S.A. **Missouri:** cultivated at Missouri Botanical Garden 1996–2002, from seeds from Meerman's cultivated type plants, received Oct. 1996, *MacDougal 6035* (MO). BELIZE. **Belize:** Gracy Rock, 17°23′N, 88°26″W, 1996, *Meerman JM048 /JMP034* (MO). **Cayo:** Tapir Mountain Nature Reserve, 17°09′N, 88°51′W, UTM 16.303 E, 1897 N, 2 Dec. 1994, *Meerman s.n./JM017B* (MO). **Toledo:** southwestern Maya Mountains, Columbia River Forest Reserve, Union Camp, dry hills E and N of camp, 16°23′N, 89°09′W, 6 Apr. 1992, *Holst 4144* (MO); Maya Mountains, Bladen Nature Reserve, Upper Bladen Branch basin, hill immediately E of "AC Camp," ca. 1 km SW of Ek Xux ruin, 16°29′40″N, 88°54′30″W, 21 May 1996, *Holst & Davidse 5459* (BRH). HONDURAS. **Atlántida:** Lancetilla Valley, near Tela, ca. 15°42′N, 87°28′W, 6 Dec. 1927–20 Mar. 1938, *Standley 55285* (F, US), *Standley 56831* (F, photo: DUKE, HUA, MO; US).

2. Passiflora pedicellaris J. M. MacDougal, sp. nov. TYPE: Guatemala. Baja Verapaz: Niño Perdido, 15°10′N, 90°06′W, on Arroyo El Caracol, 6 km, 300–600 m, 23 June 1977 (bud, fl, imm. fr), *C. L. Lundell & E. Contreras 21209* (holotype, LL; isotypes, LL, MO). Figures 3, 4, 5.

Haec species *Passiflorae microstipulae* similis, sed ab ea nectariis petiolaribus deminutis carentibusve, foliis angustius ovatis, androgynophoro breviore atque nodis flores unum duosve tantum gerentibus distinguitur.

Vine, glabrous except minutely puberulent with straight, possibly glandular trichomes on the prophylls of the vegetative bud, the hypanthium and sepals, and the ovary; stems terete. Stipules 0.6–1.2 × 0.1–0.2 mm, linear-triangular, late deciduous; petioles eglandular or 1-glandular near or slightly distal to the middle, the nectary 0.8–1.8 × 0.2–0.4 mm; laminas 9.5–16 × 5.5–10 cm, not peltate, or subpeltate 2–5 mm from the margin, the base cordate, entire, not variegated at maturity, ovate (narrowly ovate), unlobed, acute; laminar nectaries absent; prophylls of vegetative bud 2, 1.1–2.5 mm long, narrowly triangular, slightly keeled at base, one usually slightly shorter, sometimes with a small marginal tooth. Peduncle (common peduncle of tendril and flower) 1 per node, reduced to near absence (then the flower appearing axillary at the base of the tendril) or up to 0.5 cm long, 1(2)-flowered, the pedicels 0.5–1.5 cm; bracts 1.1–1.9 × 0.3 mm, linear-triangular. Flowers white, the corona yellow; floral stipe 28–36 mm (to 40 mm in fruit); sepals 17–19 × 9 mm, ovate-oblong, greenish abaxially, whitish adaxially, with no projection; petals 17–18 × 9 mm, ovate-oblong, white; coronal filaments in ca. 3 series, the outer 11–13 mm, linear, basally yellow-green, distally bright to dark yellow, no purplish red banding seen, the inner ca. 2 series 2–5 mm, light greenish or yellow-green marked with purplish red; operculum 3 mm, membranous, plicate; limen floor pale with purplish ring or markings, the base of the androgynophore not colored; androgynophore 7.0–8.5 mm; anthers ca. 4 mm; ovary 3.0 × 1.7 mm, ellipsoid, sparsely to lightly puberulent with straight, possibly glandular, erect trichomes, styles ca. 4–6 mm long including stigmas, glabrous. Fruit known only from immature but apparently full-sized specimen, ca. 13 × 5.5–6 cm including a 20–25 mm long stipe, ellipsoid, apically somewhat conical, exocarp very thin, immature color green, apparently inflated; arils unknown; immature seeds 6 × 5 mm, punctate-reticulate in the center, with conspicuous 1 mm wide wings at the margins.

This species is known only from the type collection from tall moist forest in Baja Verapaz, Guatemala. A single unbranched pedicel is borne off a short to obsolete peduncle at or near the base of the tendril; rarely a second pedicel is borne more distally. Out of the dozen inflorescences in the type material only one tendril/peduncle had a second branch. With such limited material it is difficult, of course, to generalize about a complex character such as the inflorescence structure, especially when that is known to be variable in the related species. Nevertheless, it seems that this species normally sports only one flower per node, unlike its sisters in the section, which usually have 2 to 5 flower buds per node. The inflorescence structure, with the common peduncle much reduced to basically lacking, is most similar to *P. lancetillensis*, which also has very short peduncles. The floral stipe (that part of the pedicel distal to the articulation) is unusually long in both these species. Before the flowers of *P. lancetillensis* had been discovered, I chose the specific epithet, *pedicellaris*, to highlight this feature. The flower has an outer corona that is blunt and yellow, like most of the rest of the section, but unlike *P. lancetillensis*.

Passiflora pedicellaris is notable in this section in that the petiolar nectaries are very reduced or absent, the few single narrow stubs seen on the petioles of the type perhaps not even functional. These glands are inconspicuous and probably are not functioning as egg mimics. The glands are rather similar to those seen on seedlings and juveniles of its relative, *P. microstipula* (Gilbert & MacDougal, 2000). The fruit is similar in shape to that of the Oaxacan clone of *P. microstipula*, but is slightly larger. This poorly understood species is

Figure 4. *Passiflora pedicellaris* J. M. MacDougal. Holotype specimen conserved at LL. Scan by Fred Keusenkothen (MO).

Figure 5. *Passiflora pedicellaris* J. M. MacDougal. A pressed dried flower from the LL holotype. Scale marked in mm.

most probably a medium-sized woody vine to canopy liana like its sisters in the section. The vernacular name, "*granadia*," appears on the label of the type collection.

3. Passiflora microstipula L. Gilbert & J. M. MacDougal, Lundellia 3: 1, fig. 1, cover plate. TYPE: U.S.A. Texas: Travis Co., cultivated at The University of Texas at Austin, 1978–2000, *L. E. Gilbert 9271*, anno 1979, specimens grown from seeds collected 13–16 July 1978 in Mexico, Veracruz, Estación Biológica Los Tuxtlas, (seed *Gilbert 7828*) (holotype, MEXU; isotypes, MO, TEX, UPCB, XAL).

Distribution. Mexico: Oaxaca, Veracruz, 20–350 m.

4. Passiflora eueidipabulum S. Knapp & Mallet, Ann. Missouri Bot. Gard. 71: 1070, figs. 2, 3b. 1984. TYPE: Panama. Colón: Santa Rita Ridge Road 7 km from the Transisthmian Hwy., 9°22′N, 79°40′W, 200 m, 21 May 1982, *S. Knapp & Schmalzel 5256* (holotype, MO; isotypes, PMA, TEX).

Distribution. Costa Rica: Puntarenas. Panama: Coclé, Colón, 200–1000 m.

Acknowledgments. Lawrence E. Gilbert at the University of Texas at Austin first recognized the distinctiveness of this group and proposed a higher taxonomic placement. He recorded the main characteristics and biology of the section, and he has given the name. The other nomenclatural co-author is Jan Meerman of Green Hills Butterfly Ranch in Belmopan, Belize. Jan was able to grow *P. lancetillensis* to maturity and make specimens and studies of the flowers, fruit, and natural history of the species. Jan's photographs, map, and observations have greatly contributed to this work. Together we were able to fashion a detailed description for this new species, otherwise known from fragmentary material. Roy Gereau generously translated the Latin diagnoses. We thank Tom Wendt of TEX for his help with Lundell's collecting localities, and Rick Clinebell of MO for his identification of the bee. We acknowledge financial support to A. K. Hansen from an NSF Doctoral Dissertation Improvement Grant. The curators of BRH, DUKE, F, LL, TEX, and US kindly allowed loans of material from their herbaria.

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Notes on Grasses (Poaceae) for the *Flora of China*, II: Paniceae

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ABSTRACT. This paper comprises nomenclatural changes needed for the *Flora of China* account of Poaceae tribe Paniceae. The new combinations *Digitaria fujianensis* and *Pseudoraphis sordida* are proposed for nomenclatural reasons. The varietal combination *Ottochloa nodosa* var. *micrantha* is validated and lectotypified. *Pseudoraphis balansae* is lectotypified, and *P. longipaleacea* is placed in synonymy. *Urochloa cordata* is reduced to synonymy under *U. setigera*. The three species of the genus *Pseudoraphis* occurring in China are reviewed and a key is provided. African specimens previously considered conspecific with Asian *Urochloa setigera* are shown to belong to a different species, *Urochloa trichopodioides*, which is lectotypified.

Key words: Africa, Asia, China, *Digitaria*, *Ottochloa*, Poaceae, *Pseudoraphis*, tribe Paniceae, *Urochloa*.

During work on the tribe Paniceae for the grass family account for the *Flora of China*, the following nomenclatural changes were found to be necessary. The opportunity is also taken here to briefly review the species of *Pseudoraphis* occurring in China, as there has been much confusion in the application of names.

DIGITARIA HALLER

Digitaria fujianensis (L. Liou) S. M. Phillips & S. L. Chen, comb. nov. Basionym: *Leptoloma fujianensis* L. Liou, Bot. Res. Academia Sinica 1: 41, f. 1. 1983. TYPE: China. Fujian: Lian-cheng, 20 Sep. 1932, *Ling Yung 3339* (holotype, PE).

This species belongs to the small group of *Digitaria* that was formerly separated as *Leptoloma* because of the diffuse paniculate inflorescence, for example by Hitchcock (1935: 563). However, the spikelets are typical of *Digitaria*, and the inflorescence may merely be an extreme expression of a loosening of the racemes seen elsewhere in this variable genus. *Digitaria fujianensis* is similar to *D. cognata* (Schultes) Pilger from the eastern United States, but this has smaller (2.5–3 mm) spikelets and shorter leaf blades. *Digitaria tomentosa* (Koenig) Henrard from Thailand and southern India also has an open paniculate inflorescence, but differs by its broader leaf blades up to 8 mm wide, and especially by the smaller (2.2–2.5 mm) spikelets with tiny glumes.

OTTOCHLOA DANDY

Ottochloa nodosa (Kunth) Dandy var. **micrantha** (Balansa ex A. Camus) S. M. Phillips & S. L. Chen, comb. nov. Basionym: *Hemigymnia arnottiana* Stapf var. *micrantha* Balansa ex A. Camus, in Lecomte, Fl. Indo-Chine 7: 455. 1922. TYPE: Vietnam. Tonkin, Lankok valley, 11 Oct. 1887, *B. Balansa 1609* (lectotype, designated here, K).

This is a small-spiculate variant of *Ottochloa nodosa*, a rambling grass widespread in shady places in the Old World tropics. The paniculate inflorescence can be variable, with the spikelets usually arranged in bunches or small dense racemelets along the primary branches, but sometimes looser with less obvious spikelet clusters. The spikelets are normally about 3 mm long, but some specimens from southern China (Guangdong and Hainan) and Vietnam have smaller (2–2.5 mm) spikelets that are always borne in neat appressed racemelets. This variant has long been recognized as meriting separate status, but the name has never been validly published in *Ottochloa*.

The genus *Hemigymnia* Stapf (1920) is illegitimate, as it is a later homonym of *Hemigymnia* Griffith (1842), but the epithet *micrantha* is validly published and available.

P. C. Keng (1976: 160) was the first to transfer the taxon to *Ottochloa* as *O. nodosa* var. *micrantha* (Balansa ex A. Camus) P. C. Keng, but the combination is invalid because it lacks the basionym ref-

erence (Art. 33.3 of the ICBN; Greuter et al., 2000). T. D. Zhuang also placed it in *Ottochloa* (1990: 222), attributing the combination to P. C. Keng, but again the combination is invalid because it lacks a correct basionym author and reference (Art. 33.3).

This taxon was first recognized by Balansa (1890: 142) as *Panicum nodosum* Kunth var. *micrantha*, a nomen nudum based on three of his collections (*Balansa 480, 1609, 1610*). These collections are all represented in the Kew herbarium, and the best is selected here as lectotype.

Pseudoraphis Griffith

Pseudoraphis is a small genus of closely related species occurring from India to China and Japan and in southeast Asia and Australia. There is no overall account of the genus, and specimens have frequently been assigned to the most widespread species, *P. spinescens* (R. Brown) Vickery, both in the herbarium and literature, which in fact belong to other species. One of these species of *Pseudoraphis* is known under an incorrect name. The species of *Pseudoraphis* occurring in China are set out below, with notes on differences from *P. spinescens*. The following key lists the main distinguishing characters.

Key to the Species of *Pseudoraphis* in China

1a. Inflorescence open, lanceolate to ovate; racemes spreading, 2–3-spiculate . . . . . *P. brunoniana*
1b. Inflorescence contracted, linear or oblong; racemes erect, usually 1-spiculate.
  2a. Spikelets numerous (more than 30); upper glume longer than lower lemma, narrowly acuminate; lower lemma 7-veined; 2 stamens in lower floret . . . . . *P. sordida*
  2b. Spikelets 10 or less; upper glume slightly shorter than lower lemma, acute; lower lemma 13-veined; 3 stamens in lower floret . . . . . *P. balansae*

Pseudoraphis brunoniana (Wallich & Griffith ex Griffith) Griffith ex Pilger, Not. Bot. Gart. Berlin 10: 210. 1928. Basionym: *Panicum brunonianum* Wallich & Griffith ex Griffith, J. Asiat. Soc. Bengal 5: 574. 1836. *Chamaeraphis spinescens* (R. Brown) Poiret var. *brunoniana* (Wallich & Griffith ex Griffith) J. D. Hooker, Fl. Brit. Ind. 7: 62. 1896. *Chamaeraphis brunoniana* (Wallich & Griffith ex Griffith) A. Camus, in Lecomte, Fl. Gen. Indo-Chine 7: 479. 1922. TYPE: Bangladesh ("Bengal"). Sylhet district, near Goalnuyar, 28 Sep. 1835, *W. Griffith* (locality uncertain).

Distribution. Northeastern India, Myanmar, Thailand, southeastern China, Taiwan, Vietnam, the Philippines.

This species was originally described as *Panicum brunonianum* by Griffith (1836), but in a later publication (Griffith, 1851a, Notulae: 29) he gave it a new name in *Panicum*, *P. intermedium*, based on the same specimen. *Panicum intermedium* Griffith is therefore an illegitimate superfluous name according to the ICBN (Art. 52.1; Greuter et al., 2000). In the 1851 *Notulae* the combination *Pseudoraphis brunoniana* is also listed, apparently as a synonym or alternative name for *Panicum intermedium*, and is therefore invalid (Art. 34.1). To complicate matters further, the illustrations published to accompany the *Notulae* (Griffith, 1851b, Icones, t. 145, fig. 1), revert to the earlier valid name *Panicum brunonianum*. Both the Griffith *Notulae* and *Icones* of 1851 were arranged and published posthumously by John M'Clelland, which probably accounts for the confusion. The combination *Pseudoraphis brunoniana* was first made validly by Pilger in 1928.

The name *Holcus natans* Roxburgh ex J. D. Hooker (1896: 62) is invalid, as it was published as a synonym of *Chamaeraphis spinescens* var. *brunoniana* (Art. 34.1; Greuter et al., 2000). It is based on a specimen from "Lower Bengal" in *Herb. Roxburgh* (K).

There is a Griffith specimen in the Kew herbarium, collected on 28 September 1835, but with the locality "Jheel of the Magna." The inflorescence is young with almost erect branches, and therefore does not correspond to the ovate inflorescence described in the protologue. The original drawing by Griffith for his *Icones* (1851b, t. 145) is in the archives of the Kew library. This depicts an ovate inflorescence, but bears the date "Sept. 17.37." No lectotypification is made here because of the possibility that the holotype from Goalnuyar may still be extant in Calcutta.

Pseudoraphis brunoniana was mistakenly stated by Bor (1960: 353) to occur in Ceylon. The grass described under this name from Ceylon by Lazarides (1994: 383) is a specimen of *P. spinescens*. In fact, specimens from throughout the range of this species have usually been assigned to *P. spinescens*. It was evident, when examining specimens from China, that they differed in several important respects from material from Australia (including the type of *P. spinescens*) and also most material from India.

Bor distinguished *Pseudoraphis spinescens* and *P. brunoniana* on spikelet size, and this has been the cause of confusion. Both species are variable in this character, and specimens used by Bor from northeast India (Assam, Bengal) and adjoining parts of Myanmar have exceptionally large spikelets. *Pseudoraphis spinescens* has racemes with 5 to 10 or

more spikelets lying more or less end-to-end, whereas racemes in *P. brunoniana* bear only 2 or 3 (occasionally 1) distant spikelets, usually with a longer terminal bristle, resulting in an immediate difference in facies. The culm nodes in *P. spinescens* are sericeous, appearing as a shiny white band of appressed silky hairs, whereas the nodes in *P. brunoniana* are merely pubescent. There is also a subtle difference in spikelet shape, as *P. spinescens* has a caudate upper glume much exceeding the lower lemma, while in *P. brunoniana* the glume is narrowly acuminate and extends beyond the lower lemma to a lesser extent.

The few specimens seen from China are cited below.

CHINA. **Guangdong:** Guangzhou [Canton], Apr. 1878, *T. Sampson 367* (K), May 1864, *Sampson in Herb. Hance 11077* (K), May 1884, *T. Sampson s.n.* (K).

Pseudoraphis sordida (Thwaites) S. M. Phillips & S. L. Chen, comb. nov. Basionym: *Panicum sordidum* Thwaites, Enum. Pl. Zeyl. 443. 1864. TYPE: Sri Lanka. *G. Thwaites C.P. 3857* (isotype, K).

Chamaeraphis spinescens var. *depauperata* Nees ex J. D. Hooker, Fl. Brit. Ind. 7: 62. 1896. *Pseudoraphis depauperata* (Nees ex J. D. Hooker) Keng, Sinensia 11: 43. 1940. *Chamaeraphis squarrosa* (L. f.) Merrill var. *depauperata* (Nees ex J. D. Hooker) Masamune, Trans. Nat. Hist. Soc. Formosa 30: 18. 1940. *Pseudoraphis squarrosa* (L. f.) Chase var. *depauperata* (Nees ex J. D. Hooker) Hara, J. Jap. Bot. 17: 398. 1941. *Pseudoraphis spinescens* var. *depauperata* (Nees ex J. D. Hooker) Bor, Grasses of Burma, Ceylon, India and Pakistan: 354. 1960. TYPE: India. *R. Wight 1654* (holotype, K).

Pseudoraphis ukishiba Ohwi, Act. Phytotax. Geobot. 10: 273. 1941. TYPE: Japan. Hondo, Shimamura, 25 Aug. 1931, *Hashimoto s.n.* (holotype, KYO).

Distribution. India, Ceylon, China, Japan, Korea.

Bor (1960: 352) aptly described this grass as having a "*Pennisetum*-like" inflorescence. The contracted inflorescence is indeed quite different from the open inflorescence of *P. spinescens*, of which it was made a variety by Bor and others. Both Keng and Ohwi recognized its separate specific status, but unfortunately overlooked the epithet from Ceylon. The habit is more slender than that of *P. spinescens*, and the internodes are frequently purple-tinged. It also differs by its clearly ciliate ligule and the presence of only two stamens. This species was omitted from the recent account of the genus in Ceylon (Lazarides, 1994).

Steudel (1854) made it quite clear that he was placing this taxon as a variety under *Panicum asperum* Wight, citing the manuscript name *Chamaeraphis depauperata* Nees as basionym, but he did not definitely make the varietal combination (Art. 33.1; Greuter et al., 2000). The name *C. depauperata* was also not validly published as a species by Steudel, as it is included under *Panicum asperum* (itself an illegitimate homonym). The earliest valid name at specific level for this grass is *Panicum sordidum* Thwaites. The necessary new combination under *Pseudoraphis* is made here.

Pseudoraphis balansae Henrard, Blumea, Suppl. 1: 230, t. 17. 1937. TYPE: Vietnam. Annam, 25 Oct. 1886, *Balansa* in Herb. Lugd. Bat. 908. 85-1414 (lectotype, designated here, L).

Pseudoraphis longipaleacea Chia, Fl. Hainan. 4: 442, 540, f. 1232. 1977. Syn. nov. TYPE: China. Hainan I.: Dongfang, 12 Sep. 1936, *Liou 27870* (holotype, SCBI not seen).

Distribution. Vietnam, Thailand, China (Hainan).

This species appears to be of restricted distribution and is known from very few collections. It is distinctive in the genus because of its merely acute spikelets lacking the drawn-out narrow apex on the upper glume found in most species. The short subacute leaves, white-membranous truncate ligule, and few-spiculate inflorescence are also characteristic.

There are three sheets of this species collected by Balansa in the Leiden herbarium, which have been annotated by Henrard as types, and seven other Balansa sheets, all of which are probably duplicates of the same collection. None bear collecting numbers, only herbarium sheet numbers. Henrard in his protologue stated there are "specimina multa legit Balansa." The sheet selected here as lectotype is chosen because it corresponds to a sheet number given by Henrard. The specimen itself has not been seen, but its image has been checked on the Internet ⟨http://www.nationaalherbarium.nl⟩.

A photocopy of the type specimen of *Pseudoraphis longipaleacea* is available at Kew and this, together with the illustration in the protologue, clearly shows that this species is a good match with *P. balansae*.

Urochloa P. Beauvois

When writing the account of *Urochloa* for the *Flora of Tropical Africa*, Stapf (1920: 598) included some specimens from East Africa under *Panicum setigerum*, at the same time transferring the species to *Urochloa*. This species was known from India and Sri Lanka, where it is widespread, and even then

Stapf pointed out that the African specimens differed by their glabrous spikelets. He also wrote that the type was "stated to have been collected in China by Bladh; but there is no other record of its occurrence in that country," perhaps implying that he considered the collecting locality incorrect. However, *U. setigera* is now known from Myanmar and Thailand, and *U. cordata* is a good match, confirming the presence of this species in tropical southern China. *Urochloa cordata* is therefore considered to be a new synonym of *U. setigera* (see below). The type of *Urochloa setigera* Retzius, collected by Bladh in the 18th century, is in the herbarium at Lund. Although there has been no possibility to see the type, there is ample material of *U. setigera* from Asia at Kew for comparative purposes.

Stapf's treatment has been followed in recent Floras, but study of the species for the *Flora of China* has revealed a number of other differences, enumerated below. It now seems clear that two species should be recognized, as follows:

Urochloa setigera (Retzius) Stapf, in Prain, Fl. Trop. Afr. 9: 598. 1920. Basionym: *Panicum setigerum* Retzius, Obs. Bot. 4: 15. 1786. *Brachiaria setigera* (Retzius) C. E. Hubbard, in Hooker's Icon. Pl. 34: t. 3363. 1938. TYPE: China (Canton). *P. J. Bladh s.n.* (holotype, LD not seen).

Panicum affine Poiret, in Lamarck, Encycl., Suppl. 4: 273. 1816. TYPE: "Indes orientales," *Herb. Desvaux* (holotype, P not seen).

Urochloa cordata Y. L. Keng ex S. L. Chen & Y. X. Jin, Acta Phytotax. Sin. 22: 472. 1984. Syn. nov. TYPE: China. Hainan: *C. Wang 33805* (holotype, SYS).

Leaf blades 8–15 cm long, 18–24 mm wide, margins pectinate-setose, at least to the middle; nodes bearded; inflorescence axis 6–13 cm long bearing 6 to 12 racemes; spikelets pubescent, herbaceous; fertile floret with a very brief mucro 0.1 mm long.

Distribution. India, Ceylon, Myanmar, Thailand, southern China.

Urochloa trichopodioides (Mez & Schumacher) S. M. Phillips & S. L. Chen, comb. nov. Basionym: *Panicum trichopodioides* Mez & Schumacher, Notizbl. Bot. Gart. Berlin-Dahlem 7: 60. 1917. TYPE: Tanzania. Amboni, *C. Holst 2844* (lectotype, designated here, K).

Leaf blades 5.5–10 cm long, 10–18 mm wide, margins scabrid (rarely a few setae at base); nodes glabrous or pubescent; inflorescence axis 1–7 cm long bearing 1 to 7 racemes; spikelets glabrous, thinly cartilaginous, dully shining; fertile floret with a pronounced mucro 0.4–0.6 mm long.

Distribution. Kenya, Tanzania, southern Ethiopia, eastern Congo.

Urochloa trichopodioides was described based on two syntype specimens from Tanzania: Amboni, *C. Holst 2844* (syntype, B; isosyntype, K), and Bukoba, *Herb. Amani 5333* (syntype, B). The species is lectotypified here on the Holst specimen at Kew, which is a good, fully representative collection.

The most important differences between these two species are summarized in the following couplet.

KEY TO DISTINGUISH *UROCHLOA SETIGERA* AND *U. TRICHOPODIOIDES*

1a. Spikelets pubescent; fertile floret with tiny mucro ca. 0.1 mm; racemes 6 to 12; margins of leaf blades pectinate-setose . . *Urochloa setigera* (Asia)

1b. Spikelets glabrous; fertile floret with pronounced mucro 0.4–0.6 mm; racemes 2 to 6; margins of leaf blades scabrid . . . . . *Urochloa trichopodioides* (Africa)

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Validation of the Name *Astragalus yumenensis* (Fabaceae), a Species Endemic to China

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ABSTRACT. While preparing the account of *Astragalus* L. (Fabaceae) for the *Flora of China*, Volume 10, it was noticed that one species, *A. yumenensis* S. B. Ho, described from Gansu Province in 1983, was invalidly named because two types (one flowering and one fruiting) were designated. The name is validated here, with the fruiting specimen designated as the holotype.

Key words: *Astragalus*, China, Fabaceae.

Astragalus yumenensis will be accepted as a species endemic to Gansu Province, China, by Xu and Podlech in their forthcoming account of *Astragalus* in *Flora of China*, Volume 10 (in prep.). *Astragalus yumenensis* was accepted, without comment on its validity, by Ho (1993: 316) in his account of Chinese *Astragalus* subg. *Cercidothrix* Bunge. It is most similar to *A. scoparius* Schrenk (subsp. *scoparius*; see Ghahremani-nejad, 2001), from northern Xinjiang Autonomous Region and Kazakhstan, and *A. sogotensis* Lipsky, from the same regions as well as Kyrgyzstan. All three species belong to *A.* subg. *Cercidothrix*, characterized by the presence of medifixed or forked (vs. simple and basifixed) trichomes and a non-inflated fruiting calyx that does not fully envelop the legume. This subgenus has nearly 800 species distributed in the Old World (Ghahreman et al., 2002), from the Mediterranean region to central Asia, with about 70 species in China. *Astragalus scoparius*, *A. sogotensis*, and *A. yumenensis* share the following characters: stems usually less than 5 cm or plants acaulescent; stipules free or connate at base; leaves imparipinnate, rachis not hardening; peduncles equaling or longer than leaves; racemes lax; calyx not bracteolate; corolla with standard oblong or narrowly so, wings emarginate or 2-lobed at apex; legume non-inflated. They may be distinguished with the following key:

KEY TO *ASTRAGALUS SCOPARIUS A. SOGOTENSIS*, AND *A. YUMENENSIS*

1a. Calyx teeth subulate, ⅓–½ as long as tube . . . . . *A. yumenensis*
1b. Calyx teeth subtriangular, ⅙–¼ as long as tube.
  2a. Legume with both black and white trichomes; leaflets in 3 to 6 pairs . . *A. scoparius*
  2b. Legume with only white trichomes; leaflets in 2 or 3 (or 4) pairs . . . . . *A. sogotensis*

A nomenclatural problem exists with *Astragalus yumenensis*. Two specimens, representing two gatherings, were simultaneously designated as types. Both are from Gansu: one flowering, "Jiuquan ad Yumen," 19 May 1957, *K. J. Kuan 421* (PE), and one fruiting, "Sunan Yugurzu Zizhi Xian, daheba-tangeltan, in declivitate sicco, alt. 2540 m," 2 Aug. 1967, *Hexi Expedition 126* (PE). The name is therefore invalid under Articles 8.1 and 37.1 of the ICBN (Greuter et al., 2000). The name is validated here by reference to the previously and effectively published Latin diagnosis and full Latin description by Ho (1983: 65–66) and by designating the fruiting specimen, *Hexi Expedition 126*, as the holotype. The fruiting specimen is preferable to the flowering one because it is the more useful for diagnostic purposes.

Astragalus yumenensis S. B. Ho ex Podlech & L. R. Xu, sp. nov. *Astragalus yumenensis* S. B. Ho, Bull. Bot. Res., Harbin 3(1): 65–66, pl. 18. 1983, nom. inval. TYPE: China. Gansu: Sunan Yugurzu Zizhixian, "Dahebatangeltan [sic!], in declivitate sicco," 2540 m, 2 Aug. 1967 (fr), *Hexi Expedition 126* (holotype, PE, photograph seen).

Plants 15–30 cm tall, shortly caulescent; caudex strong, with a many-headed root crown; stems several, short, 2–10 cm, densely covered with medifixed, appressed, white trichomes 0.6–1 mm. Leaves 5–12 cm; stipules 4–5 mm, triangular, shortly adnate to petiole, with white, appressed trichomes; petiole 2–5 cm, together with rachis with trichomes like stem; leaflets in 2 or 3 pairs, linear, 10–25 × 1–3 mm, on both surfaces sparsely to rather densely covered with appressed trichomes 1–1.5 mm. Peduncle 7–15 cm, with trichomes like stem but toward raceme with some black trichomes intermixed; raceme rather dense, 3–4 cm; bracts narrowly triangular, 2–3 mm, membranous, loosely with predominantly black trichomes; pedicels 1–2 mm, with black trichomes. Calyx narrowly tubular, obliquely cut at mouth, 8–12 mm, rather densely covered with appressed black (predominantly) and white trichomes (0.3–)0.5–0.8 mm; teeth subulate, 2–4 mm; corolla purple-red; standard 17–20 mm, limb narrowly obovate, 6–7 mm wide, narrowed into a short claw at base, apex retuse; wings 14–18 mm, claw 7–9 mm, auricle rounded, ca. 0.2 mm, limb narrowly oblong, 7–8 × 2–2.5 mm, apex distinctly incised; keel 10–15 mm, claw 6–9 mm, auricle minute, limb obliquely obovate, distally with broadly curved lower edge and slightly concave upper edge, 5.5–6 × 2–2.5 mm, apex acute; stamen tube subtruncate at mouth; ovary subsessile, linear, covered with appressed white and black trichomes; style glabrous. Legume sessile, 2-valved, straight to slightly curved, 10–15 mm, ca. 2 mm wide and high, grooved abaxially, slightly keeled adaxially, apex shortly acuminate; valves with appressed white and black or predominantly black trichomes. Seeds 3 or 4 in each valve.

Phenology. Flowering in May and June, fruit ripening from June to August.

Habitat. Dry slopes in steppes, gullies of alluvial fans in deserts; 2000–3000 m.

Distribution. Endemic to northwestern Gansu Province, China.

Vernacular name. Yu men huang qi.

Paratypes. CHINA. **Gansu:** Aksay Kazakzu Zizhixian, 1950 m, 14 May 1996, *L. R. Xu 96-188* (MSB); "Jiuquan ad Yumen," 19 May 1957 (fl), *K. J. Kuan 421* (PE).

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A New Species of *Bashania* (Poaceae: Bambusoideae) from Mt. Qinling, Shaanxi, China

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ABSTRACT. The new species *Bashania aristata* of Bambusoideae (Poaceae) from the giant panda's habitat of Mt. Qinling, Shaanxi, China, is described and illustrated. The new species differs from *B. fargesii* in its fully developed culm sheath auricles and aristate lemmas and from *B. qingchenshanensis* in its fully developed culm sheath auricles and in its lack of auricle leaf sheaths. Its relationship to the other species of *Bashania* is discussed along with the status of this genus.

Key words: Bambusoideae, *Bashania*, China, Poaceae.

Bashania Keng f. & T. P. Yi was described (Keng & Yi, 1982) for *Arundinaria fargesii* E. G. Cames because *Arundinaria* Michaux is endemic to North America, and they differ from each other both in the flowers and the number of primary branches per culm node. It is readily distinguished from the related Chinese *Gelidocalamus* T. H. Wen by longer branches growing from the culm, and the presence of secondary branches, and more than two leaves on the terminal twigs. *Gelidocalamus* has short branches from the culm, without secondary branches, and with one or two leaves on the twigs.

The genus *Bashania* consists of seven species: *B. fargesii*, *B. qingchengshanensis* (Keng & Yi, 1982, 1996), *B. faberi* (Yi, 1993) (= *B. fangiana*, Wen, 1985; Keng & Yi, 1996), *B. spanostachya* (Yi, 1989; Keng & Yi, 1996), *B. baoxingensis* (Yi, 2000), *B. auctiaurita* (Yi, 1986), and the new species *B. aristata*, most of them endemic to Sichuan and adjacent Shaanxi, Gansu, Hubei, Hunan, and Yunnan Provinces of China.

The new species, *Bashania aristata*, is common in Foping National Nature Reserve and can also be found in Changqing National Nature Reserve and other areas of Shaanxi Province. These reserves are the main distribution of the giant panda on Mt. Qinling. When we surveyed the plants in the habitat of the giant panda in Mt. Qinling in 1999, we found that some individuals of *Bashania* were flowering but some were not. The flowering individuals and non-flowering individuals were distributed in staggered plots in the area named Sanguanmiao in Foping National Nature Reserve. This phenological pattern was abnormal according to the common knowledge of the flowering behavior of bamboo, and it was assumed that there was only one species, *B. fargesii*, distributed in the reserve. After comparison of the flowering and non-flowering individuals, we found that the flowering individuals differed in having aristate lemmas and auricular culm sheaths. Further survey indicated that the same phenomenon also existed in another giant panda reserve, Changqing National Nature Reserve located south of Foping National Nature Reserve, as well as other areas in Mt. Qinling. The staggered distribution of *B. aristata* and *B. fargesii* correlates with the absence of any report of wholesale bamboo death after flowering over a large area in the forest of *Bashania* in the giant panda's habitat on Mt. Qinling.

Bashania aristata Y. Ren, Y. Li & G. D. Dang, sp. nov. TYPE: China. Shaanxi: Foping County, Sanguanmiao, Chaoyangpo, 33°39′16.875N, 107°47′11.25E, 1600 m, 28 Apr. 1999, *Ren Yi 906* (holotype, WNU; isotype, MO). Figure 1.

Species differt a *B. fargesii* vaginis auriculatis, lemmis aristatis, a *B. qingchenshanensi* vaginis auriculatis, auriculis foliorum carentibus.

Rhizome leptomorph, monopodial, internodes

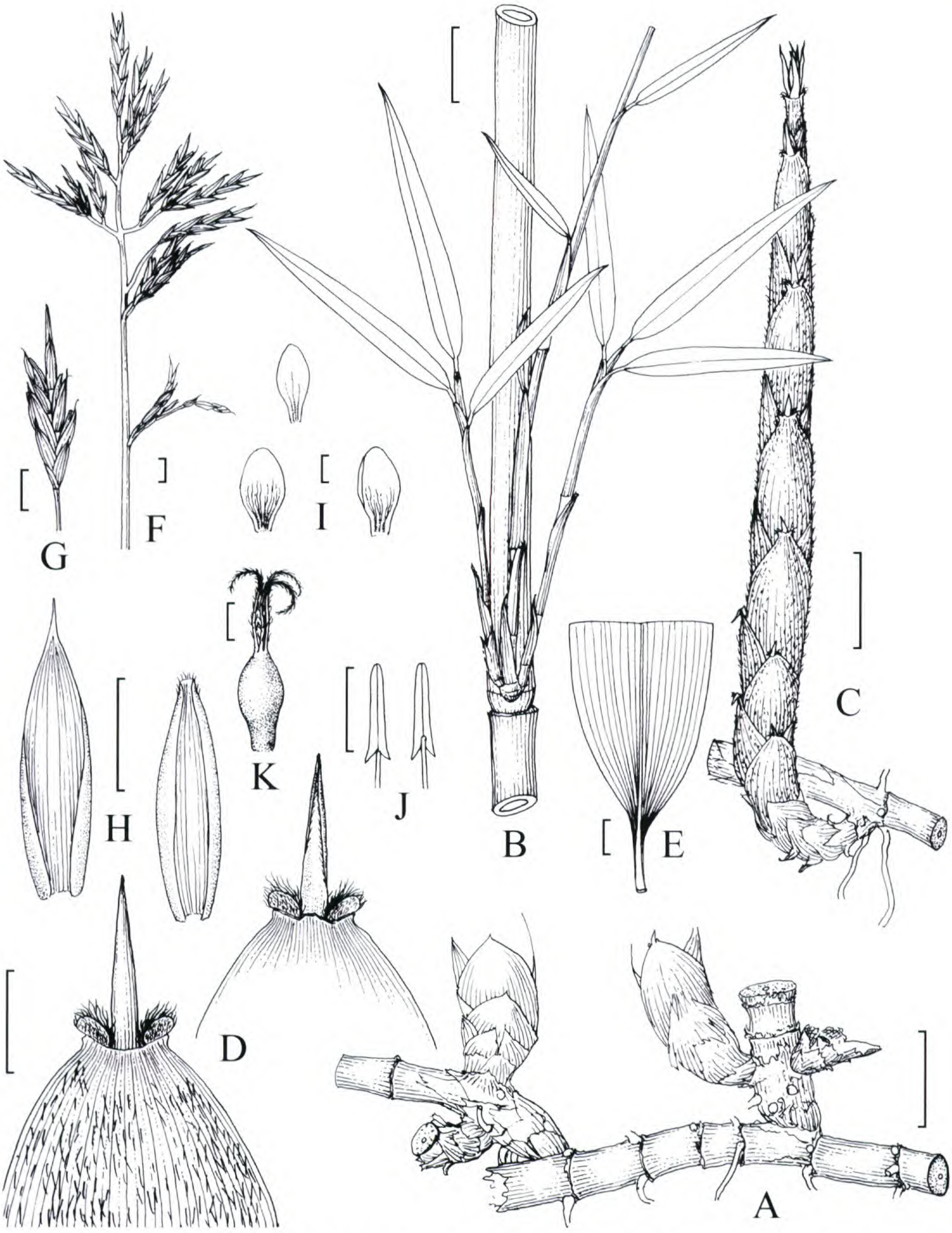

Figure 1. *Bashania aristata* Y. Ren, Y. Li & G. D. Dang. —A. Rhizome and culm base; the transverse rhizome and the left branches show the monopodial growth pattern and the right branches show the sympodial growth pattern. —B. Part of culm. —C. New shoot. —D. Upper part of a culm leaf, showing the sheath auricles and blade. —E. Base of a leaf. —F. Inflorescence. —G. Spikelet. —H. Lemma (left) and palea (right). —I. Lodicules. —J. Stamens. —K. Pistil. Scale bars: A–C = 5 cm; D, E, G = 1 cm; F, H, J = 5 mm; I, K = 1 mm. Drawn by Guo Mu-seng from the holotype, *Ren Yi 906* (WNU), at Sanguanmiao.

(1)3–5 cm long, 5–20 mm diam., hollow. Culms erect except the tips nodding, 2–8(–13) m in height, 2–4(–6.5) cm diam., deep green and with white powder when young, flavescent when old. Internodes 25–40 cm long, slightly flattened above branching complement. Walls 4–8 mm thick; culm nodes slightly bulging, nodal line salient with remnant of sheath. Bud 1 per node, flat; nodal region 6–14 mm long, glabrous. Primary branches 3, secondary branches many, but more slender than primary branches. Culm sheath leathery, shorter than the internode, green when fresh and flavescent when dry, densely covered with black to dark brown setae abaxially, dents or papillae left when hairs fall off; inner ligule 2–4 mm tall, with small setae on it, denticulate at apex; auricle fully developed, half-moon-shaped, with erect hairs on the edge; blade lanceolate, erect or curved, not easily caducous, green when young with caducous cilia at the base of upper surface. Leaves 4 to 6 on each ultimate branch, glabrous adaxially and sparsely velutinate abaxially when young, usually 7–17 × 1–2.3 cm, with 6 pairs of long veins and compact cross veins; sheath 5–10 cm long; inner ligules 1.5–4 mm tall, tomentulose and with irregular sera; auricle absent; petiole usually 0.7–0.8 cm long. Inflorescence a panicle, about 9 cm long, 3–4 cm wide, eventually exserted; the major axis and branches of the inflorescence with white microsetae. Spikelets slender cylindrical, dark brown when mature, 2–3 cm long, 3 mm diam., with 4 to 7 florets in each; rachilla internodes 2–3.5 mm long, flat, with white microsetae. Glumes ovate-lanceolate; outer glume 3–6 mm long, 1–3-veined, the inner glume 6–8 mm long, 5- to 7-nerved. Lemmas ovate to lanceolate, with white microsetae at the base, 12–13 mm long, with 7 long veins and sparse cross veins, obviously aristate. Paleas 9–10 mm long, with 2 ridges on the back and bifid at the apex. Lodicules 3, ciliate at the edge, unequal, veined at the base. Stamens 3, with anthers 4–5 mm long. Ovary ovoid; stigmas 3, feathery, about 2 mm long. Caryopsis unknown.

Habitat and distribution. The new species lives on slopes with brown-yellow forest soil under deciduous broadleaved forest and in temperate coniferous broadleaved mixed forest ranges, from 1100 to 1600 m. The soil is thick, slightly wet, and acidic, with thin humus and leaf litter.

The community of the new species is simple. The arboreous layer consists of species of *Quercus* or species of *Quercus* and *Pinus tabulaeformis*. The shrub layer consists mainly of the new species and rarely species of *Acer* and *Viburnum*. The herb layer is weakly developed and consists mainly of species of Poaceae and Cyperaceae.

The new species is distributed in Foping, Yangxian, and Zhenba Counties of Shaanxi Province, China. These counties are located on the middle part of the south slope of Mt. Qinling, which is the main distribution area of the giant panda on Mt. Qinling.

Bashania aristata is readily distinguished from the six other species of the genus. It is obviously different from *B. fangiana* and *B. spanostachya* by its longer leaves (more than 10 cm long), abaxially sparsely velutinous foliage leaves when young, with brown or dark brown setae on the back of the culm sheath and large culm sheath auricles. *Bashania aristata* is closer to *B. fargesii*, *B. qingchenshanensis*, *B. baoxingensis*, and *B. auctiaurita*, but is also readily distinguished from *B. fargesii* by its large culm sheath auricles and the aristate lemmas, and from *B. qingchenshanensis* and *B. baoxingensis* by its large culm sheath auricles and its lack of leaf sheath auricles. *Bashania aristata* is distinguished from *B. auctiaurita* by its larger stature and less falcate auricles.

Paratypes. CHINA. **Shaanxi:** Foping County, Yueba, Baimagou, 28 Apr. 2000, *Li Yun 101* (WNU); Foping County, around Sanguanmiao, 18 Oct. 2001, *Li Yun 111* (MO); Zhengba County, *Tang Jian-weng 94* (SIFS).

Key to Chinese Species of *Bashania*

1a. Leaves longer than 10 cm; culm sheath with brown or dark brown setae on the back.
  2a. Leaves sparsely velutinous on lower surface when young, leaf sheath without auricles; culm sheath without basal hair ring.
    3a. Culm sheaths without auricles; lemmas not aristate . . . . . *B. fargesii* (E. G. Camus) Keng f. & T. P. Yi
    3b. Culm sheaths with auricles; lemmas aristate . . . . . *B. aristata* Y. Ren, Y. Li & G. D. Dang
  2b. Leaves glabrous, with auricles; culm sheath with basal hair ring.
    4a. Culm sheath without auricles.
      5a. Internodes of rhizome and the base of culm almost solid . . . . . *B. qingchengshanensis* Keng f. & T. P. Yi
      5b. Internodes of rhizome and the base of culm hollow . . . . . *B. baoxingensis* T. P. Yi
    4b. Sheath on upper part of culm with auricles . . . . . *B. auctiaurita* T. P. Yi
1b. Leaves shorter than 10 cm; culm sheaths glabrous or with yellow-gray setae on the back.
  6a. Rhizome with 2 to 5 roots at the node; raceme with 3 to 5 spikelets; spikelets 2.5–4.5 cm long; lemmas 9–14 mm long; paleas

7–12 mm long; anther 5–6 mm long . . . . . *B. faberi* (Rendle) T. P. Yi

6b. Rhizome with 4 to 6 roots at the node; raceme with 2 or 3 spikelets; spikelets 1.8–3 cm long; lemmas 7–10 mm long; paleas 5–6.5 mm long; anthers 3.5–4.5 mm long . . . . . *B. spanostachya* T. P. Yi (including *B. fansipanensis*)

Species Excluded in the Key to Chinese Species

Bashania victorialis (Keng f.) T. P. Yi was first described as *Indocalamus victorialis* by Keng f. (1951), but Yi (1993) removed this species to *Bashania* according to the specimens collected from the area where the type was collected. According to Keng f. (1951), there are one or rarely three primary branches on the culm node. This species needs further study.

Bashania abietina T. P. Yi & L. Yang was described based on the specimens without flowers (Yi & Yang, 1998). According to the description, this species has one branch on the culm node, which is similar to the species of *Indocalamus* rather than *Bashania*. This species needs further study.

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Schradera reticulata (Rubiaceae), una Nueva Especie de Costa Rica y Panamá

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RESUMEN. Se describe e ilustra una nueva especie, *Schradera reticulata* (Rubiaceae, Schradereae). La nueva especie es similar a *S. rotundata* Standley ex Steyermark de Colombia. No obstante ambas se diferencian en que *S. reticulata* tiene hojas más angostas, en su mayoría oblongas a elípticas, la venación terciaria es ligeramente prominente y finamente reticulada en ambas caras de la lámina foliar, el ápice es corto acuminado, pedúnculo más largo, involucro con dientes marginales, hipanto más corto y lóbulos de la corola más largos.

ABSTRACT. A new species, *Schradera reticulata* (Rubiaceae, Schradereae), is described and illustrated here. This species is similar to *S. rotundata* Standley ex Steyermark from Colombia. The two species differ in that *S. reticulata* has narrower and generally oblong to elliptic leaves, the tertiary venation is slightly prominent and finely reticulate on both foliar sides, the apex is short-acuminate, the peduncle longer, the involucre has marginal teeth, the hypanthium is shorter, and the corolla lobules are longer.

Key words. Costa Rica, Panama, Rubiaceae, *Schradera*, Schradereae.

El género *Schradera* Vahl (Isertieae), comprende 40 especies distribuidas desde Brasil hasta Costa Rica, las Antillas, el sureste de Asia y Nueva Guinea. Se distingue por su hábito epífito, inflorescencias dispuestas en capítulos pedunculados, subtendidos por un pequeño involucro, flores semisuculentas que secan de color negro (Burger & Taylor, 1993). El género es poco conocido debido, entre otras razones, a que el hábito epífito dificulta la recolección de buenos especímenes. En Mesoamérica se considera que el género *Schradera* se encuentra representado por cuatro especies, de las cuales una está presente en Costa Rica y tres en Panamá (Taylor, en prep.). Además hay que mencionar la existencia de una especie inédita, compartida por ambos países (Taylor, 2003). Por tanto, con esta nueva especie que se describe aquí, el número total aumenta a seis.

Schradera reticulata J. Sánchez-González, sp. nov. TIPO: Costa Rica. Limón: cantón de Talamanca, Sixaola, Gandoca, El Llano entre filas Manzanillo y Río Mile Creek, 09°37′N, 82°41′W, 50–100 m, 27 Mar. 1995 (fl), *G. Herrera 7585* (holótipo, CR; isótipos, F, K, MO, US, USJ). Figura 1.

Schraderae rotundatae Standley ex Steyermark affinis qua imprimis differt foliis angustioribus, oblongis usque elipticis, nervis tertiis utrinque subtiliter reticulatis prominentibusque; apice breve acuminatis; pedunculis longioribus, involucri margine minute denticulate (sub lente 10×); hypanthio breviore; lobulis corollae longioribus.

Arbusto epífito, glabro; corteza exfoliante. Hojas 5.5–12.5 × 2–6.5 cm, elíptico-oblongas, elípticas, oblanceoladas u obovadas, cartáceas, de color café oscuro en la haz y café claro a pardo en el envés cuando secas, la base cuneada a obtusa, el ápice breviacuminado a obtuso; nervaduras secundarias 6–8 pares, ligeramente broquidódromas, impresas en la haz, prominentes y de color más claro en el envés; venación terciaria reticulada, prominente en ambas caras, formando aréolas de 0.5–1 mm de ancho; pecíolos 1–2.5 cm de largo; estípulas ca. 25 mm de largo, tempranamente caedizas, el ápice obtuso. Inflorescencias terminales, solitarias; pedúnculos 1–3.5 cm de largo; cabezuelas 1.5–2.0 cm de diámetro (sin incluir las corolas), hemisféricas a subglobosas, con 6–20 flores; involucro 0.8–1.2 cm de diámetro, margen ondulado con dientes de 0.7–2.0 mm de largo. Flores protandras, muy fragantes; hipanto turbinado, de 3–4 mm de largo; limbo calicino triangular, pulverulento hacia los márgenes, verde claro, secando negro, 3 mm de largo; corola blanca, negra cuando seca, pulverulenta interna y externamente; tubo de 0.8–1.2 cm de largo, lóbulos 5, ca. 10 mm de largo, lineares, carnosos, con un apéndice de 2 mm de largo en forma de espolón reflexo e inserto en el ápice; anteras 5, exsertas, dorsifijas, introrsas, de color amarillo tenue, secando con el conectivo oscuro y las tecas claras, 4 mm de largo; estilo villoso, estigma exserto, villoso, 25 mm de largo. Frutos jóvenes ca. 5 mm de diámetro, subglobosos.

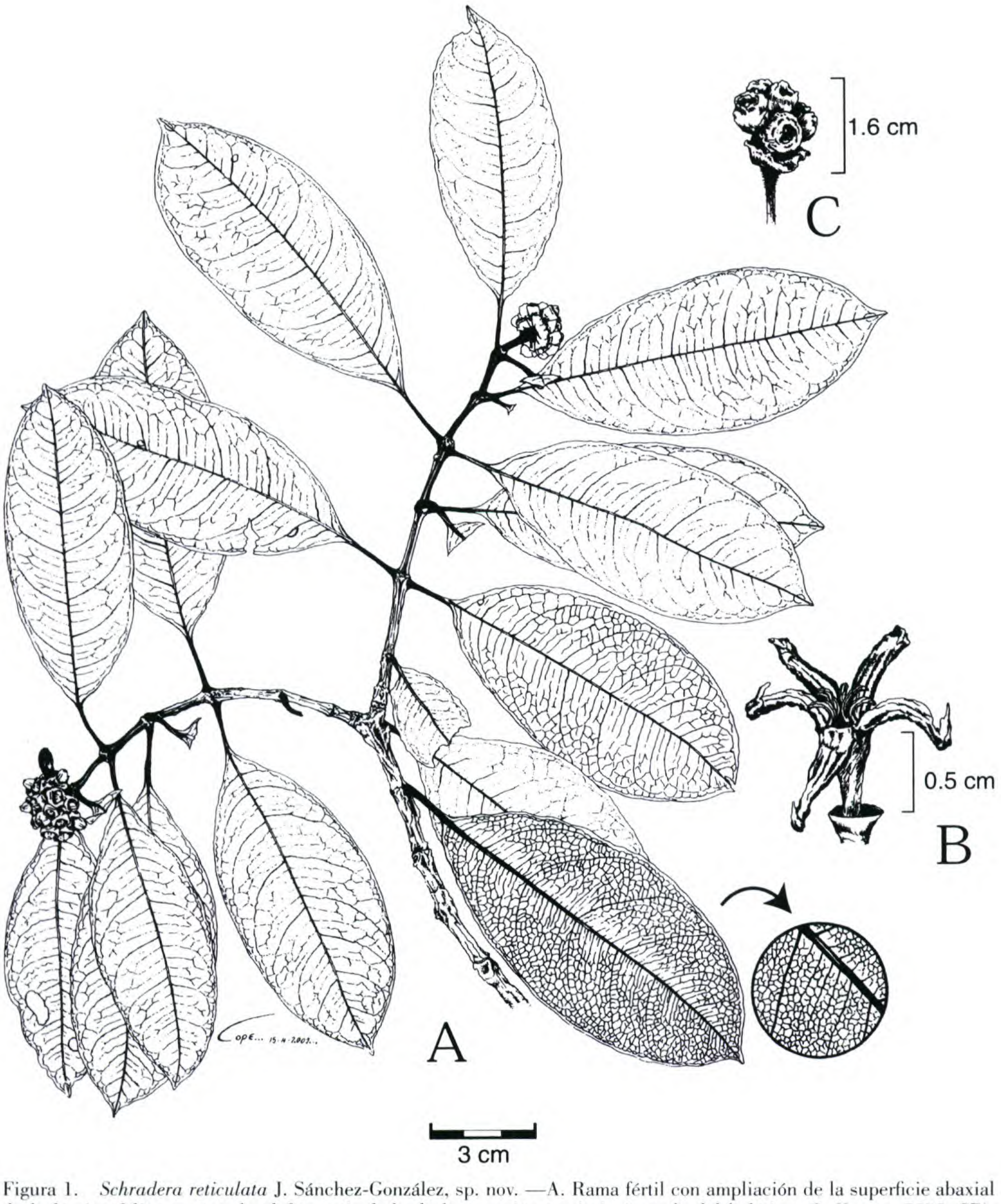

Figura 1. *Schradera reticulata* J. Sánchez-González, sp. nov. —A. Rama fértil con ampliación de la superficie abaxial de la lámina foliar mostrando el fino reticulado de la venación terciaria (tomado del holótipo, *G. Herrera 7585*, CR). —B. Flor (tomado del parátipo *G. Stiles 83-7*, USJ). —C. Infrutescencia (tomado del parátipo *J. Kirkbride, Jr. & J. Duke 1300*, MO).

Distribución, hábitat y fenología. Habita en Bosque Húmedo y muy Húmedo Tropical y en Bosque Pluvial Premontano, según Holdridge (Tosi, 1969; FAO, 1971), de 50 a 1200 m. El holótipo es el espécimen recolectado a la menor elevación del ámbito de distribución altitudinal de la nueva especie. Se distribuye por la vertiente atlántica de Costa Rica hasta la provincia de Darién en Panamá. Se han recolectado especímenes con flores en abril, mayo y julio y con frutos en abril. En el espécimen *J. Kirkbride, Jr. & J. Duke 1300* se menciona que los nativos del Chocó la utilizan para teñir la lengua de negro.

Relación con otras especies. Schradera reti-

culata es similar a *S. rotundata* Standley ex Steyermark de Colombia. No obstante, ambas especies difieren en algunas características: *S. reticulata* tiene hojas de 1–6.5 cm de ancho, en su mayoría oblongas a elípticas, la venación terciaria es ligeramente prominente y finamente reticulada en ambas caras de la lámina foliar, el ápice es corto acuminado, pedúnculo de 1–3.5 cm de largo, involucro con dientes marginales, hipanto de 3–4 mm, turbinado y lóbulos de la corola de 10 mm. En contraste, *S. rotundata* tiene hojas de 4–8 cm, ampliamente obovadas, la venación terciaria inconspicua, ápice redondeado a subtruncado, pedúnculo de 0.7 a 1.5 cm de largo, involucro sin dientes marginales, hipanto de 11 mm de largo, urceolado y lóbulos de la corola de 8 mm.

Etimología. El nombre de *Schradera reticulata* hace referencia a la venación terciaria finamente reticulada en ambas superficies de la lámina foliar. El epíteto fue utilizado como nombre de herbario por C. M. Taylor.

Parátipos. COSTA RICA. **Limón:** cantón de Talamanca, cerro entre cerro Chimú y cerro Matama, 30 abr. 1985, *L. D. Gómez et al. 23581* (MEXU, MO). **Heredia:** Parque Nacional Braulio Carrillo, 8 abr. 1983, *G. Stiles 83-7* (USJ). PANAMÁ. **Coclé:** vicinity of La Mesa, beyond El Valle, on Eastern ridge, along trail to summit of Cerro Gaital, 13 July 1987, *G. McPherson 11256* (MO). **Comarca de San Blas:** El Llano–Cartí Road, 12 mi. from Pan American Hwy., along deeply shaded large stream, wet tropical forest, 10 May 1981, *K. Sytsma & L. Andersson 4504* (MO). **Darién:** Cuasi–Cana Trail between Cerro Campamiento & La Escalera E of Tres Bocas, 30 Apr. 1968, *J. Kirkbride, Jr. & J. Duke 1300* (MO). **Panamá:** Cerro Jefe, 17 May 1968, *R. Dressler 3509* (MO).

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Aspidistra guangxiensis (Convallariaceae), a New Species from China

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ABSTRACT. In the course of our investigation of the genus *Aspidistra* (Convallariaceae), a new species was discovered in the Guangxi Zhuangzu Autonomous Region of southern China. It is described below as *A. guangxiensis* S. C. Tang & Y. Liu, and an illustration is provided.

Key words: *Aspidistra*, China, Convallariaceae, Guangxi.

Aspidistra Ker Gawler (Convallariaceae) consists of approximately 60 species of perennial, rhizomatous, evergreen herbs distributed in eastern Asia (China, India, Japan, Laos, Thailand, and Vietnam). Its center of distribution and differentiation is in southern China, where 56 native species (54 endemic) are known, most of them in the Guangxi Zhuangzu Autonomous Region (Lang et al., 1999; Liang & Tamura, 2000; Fang & Yu, 2002; He, 2002; Li & Tang, 2002). The plants grow in seasonal rain forests (monsoon forests) and evergreen broad-leaved forests. In the course of our investigation of the genus, a new species was recently discovered in Long'an County, about 75 km northwest of Nanning in southwestern Guangxi.

Aspidistra guangxiensis S. C. Tang & Y. Liu, sp. nov. TYPE: China. Guangxi: Guilin Botanical Garden, cultivated, 12 May 2002, *Y. Liu 0001*, originally collected from Guangxi, Long'an County, limestone mountains, 350 m, date and collector not recorded (holotype, IBK; isotype, IBK). Figure 1.

Aspidistrae patentilobae affinis, sed staminibus in parte tertia infera tubi affixis, stigmate conspicue inferioro, antheris reniformibus; stigmate facie supremo alutaceo, centro 3-carinatis conspicue purpureo, infero purpureo differt.

Herbs perennial, evergreen, rhizomatous. Rhizome creeping, subterete, 3–5 mm diam., densely covered with scales. Leaves solitary, spaced; petiole 14–40 cm, partly enveloped by sheaths; leaf blade ovate to elliptic, 6–20 × 7–8 cm, base decurrent into petiole, apex acuminate. Flowers solitary; peduncle decumbent, 4–5 cm; bracts purple, triangular, terminal 2 or 3 close to flower; perianth abaxially purple, adaxially yellow, urceolate, fleshy; tube subglobose, 1–2 cm diam.; lobes 6 or 8, free, spreading, linear-lanceolate, 2–3 cm × 2–6 mm, base with an adaxial, rounded, toothlike appendage extending part of the way across the mouth of the perianth tube, apex subobtuse. Stamens 6 or 8, inserted in proximal ⅓ of perianth tube, positioned conspicuously lower than stigma; filament inconspicuous; anther reniform, 2–5 mm, dehiscing by a slit. Pistil ca. 1 cm; ovary much narrower than stigma, 3-loculed; stigma sessile, dilated and bowl-like, 1–1.5 cm diam., thickened, abaxially with 12 or 16 longitudinal ridges, adaxially pale yellow and slightly concave, with 3 purple ridges at center (4 ridges not observed in 4-merous flowers), margin with 12 or 16 triangular lobes.

Phenology. Flowering in May.

Distribution. Known in the wild only from limestone mountains at 350 m elevation in Long'an County, Guangxi Zhuangzu Autonomous Region, southern China.

This new species is most similar, and probably related, to *Aspidistra patentiloba* Y. Wan & X. H. Lu (Wan, 1989: 99) in its dilated, thickened stigma, which is longitudinally ridged abaxially, slightly concave adaxially, and triangular-lobed at the margin. However, the latter species, distributed in Liujiang County in central Guangxi (200 km northeast of Long'an), differs in having the stamens inserted at the middle of the perianth tube, positioned level with the stigma, the anthers ovate, and the stigma adaxially purple with four ridges at its center.

The floral structure of *Aspidistra*, especially the stigma, is the most important taxonomic character

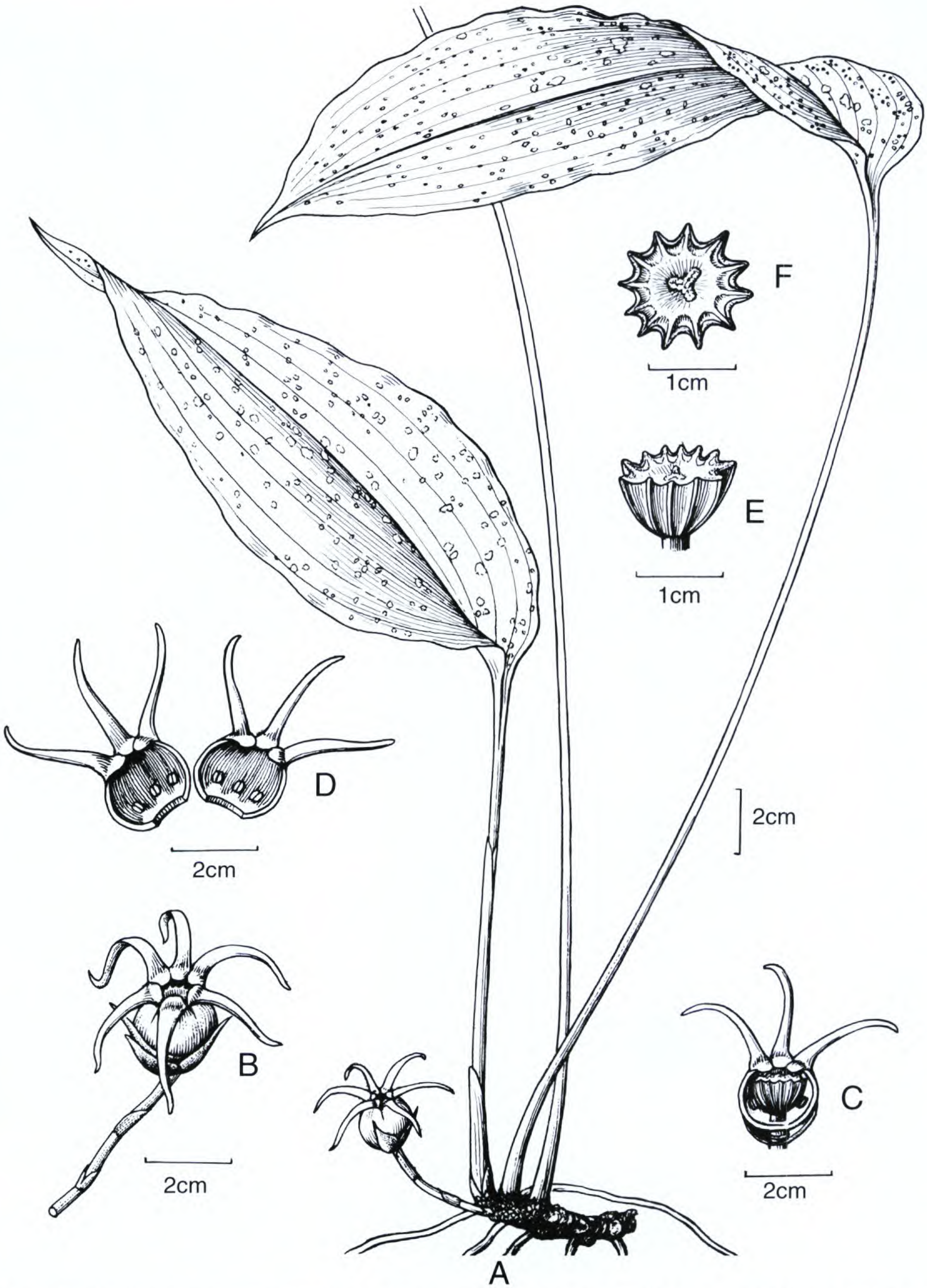

Figure 1. *Aspidistra guangxiensis* S. C. Tang & Y. Liu. —A. Flowering plant. —B. Flower. —C. Flower with half of perianth removed showing stamens and pistil. —D. Perianth bisected. —E. Stigma lateral view. —F. Stigma apical view. Drawn from the holotype, *Y. Liu 0001* (IBK), by He Shunqing.

because of its great variation (Li et al., 2000). Both *A. guangxiensis* and *A. patentiloba* have been cultivated under the same environmental conditions at the Guilin Botanical Garden, where their floral differences hold true. Furthermore, one of us (Liu) collected material of *A. guangxiensis* from the botanical garden in 2003 and observed the floral structure to be the same as that of the type material collected in 2002. This demonstrates that the distinctness of *A. guangxiensis* from *A. patentiloba* is not an artifact of cultivation and that the diagnostic floral characters of the new species are constant.

Paratypes. CHINA. **Guangxi:** Guilin Botanical Garden, cultivated, 12 May 2002, *Y. Liu 0002*, originally collected from Guangxi, Long'an County, limestone mountains, 350 m, date and collector not recorded (IBK).

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Nomenclatural Actions in *Whytockia* (Gesneriaceae)

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ABSTRACT. On the basis of morphological, anatomical, and karyotypic evidence, a change in status is proposed for *Whytockia wilsonii* (A. Weber) Y. Z. Wang, which is elevated from varietal to species level. Further, the affinity of another variety currently accepted within *W. tsiangiana* is recognized, and it is now transferred from *W. tsiangiana* as the new combination *W. hekouensis* var. *minor* (W. W. Smith) Y. Z. Wang. Illustrations of *W. wilsonii* are included along with morphological descriptions and diagnostic characters. The relationships of these and related species are discussed as well as geographic distribution. A key distinguishing these species is provided.

Key words: China, Gesneriaceae, *Whytockia*.

The genus *Whytockia* W. W. Smith includes eight species endemic to China. It was proposed by W. W. Smith in 1919 for the accommodation of *Stauranthera chiritiflora*, in which he distinguished a variety *minor*. With limited material, Weber (1982) conducted a preliminary revision of *Whytockia* in which three species were recognized. The current author has carried out systematic and evolutionary studies on *Whytockia* and its allies since 1991. Intensive research in herbaria, field, and laboratory over the last ten years has led to a better understanding of this group and to the discovery of several species previously unknown to science. The recognition of significant characters contributes to a natural delimitation of the taxa of *Whytockia*. The nomenclature of two taxa previously treated as varieties needs adjustment herein.

Whytockia wilsonii (A. Weber) Y. Z. Wang, stat. nov. Basionym: *Whytockia tsiangiana* (H. Handel-Mazzetti) A. Weber var. *wilsonii* A. Weber, Notes Roy. Bot. Gard. Edinburgh 40: 365. 1982. TYPE: China. Sichuan (Szechuan): side of stream, Sep. 1903, *E. H. Wilson 3292* (holotype, BM; isotypes, E, K). Figure 1.

Leaves opposite, strongly unequal. Larger leaf blades broadly obovate or widely ovate-oblong, 9–11 × 3–4 cm, nearly sessile or with a short petiole 2–3 mm long, base oblique, widely cuneate or rounded on the wide side to cuneate on the narrow side, margins serrate-dentate, teeth 1.5–3 mm long. Smaller leaf blades ovate, 6–13 mm long, sessile. Pair-flowered cymes emerging from the axils of the larger leaves. Sepals 5, free or connate at base, ovate or ovate-triangular, 2–3 × 1–2 mm. Corolla red or reddish, tubular and bilabiate, 1.5–2 cm long with corolla tube 10 mm long, outside glabrous, inside with 2 rows of yellow-green unicellular and clavate hairs under and between lobes of the lower lip; upper lips 3 mm long, 2-lobed; lower lips about 6.5 mm long, 3-lobed. Stamens 4, didynamous, attached to corolla base for 2 mm. Staminode long ovate, 1.1 mm long. Ovaries ovate, about 1.5 mm long; styles about 4.6 mm long; 2 stigmas only connate at base. Seeds minute, many, testa obliquely striate.

Whytockia wilsonii resembles *W. bijieensis* Y. Z. Wang & Z. Y. Li by its large corolla (1.5–2 cm long), 5 sepals free or connate at base, and 2 stigmas free or only connate at base. In addition, *W. wilsonii* and *W. bijieensis* have a karyotype ($2n = 18$) more similar to each other than to other *Whytockia*, i.e., similar frequencies of median and submedian chromosomes, and lacking a subterminal chromosome (Wang et al., 1998). However, *W. wilsonii* is easily distinguished from *W. bijieensis* by the following morphological characters, i.e., the large leaf blades of unequal leaf pairs broadly obovate or widely ovate-oblong with base widely cuneate or rounded on the wide side; blade margins serrate-dentate with teeth 1.5–3 mm long; seed testa obliquely striate. The X-shaped ventral carpellary bundle of the ovary and the anchor-shaped axile placentas are remarkably distinctive from those of other species in *Whytockia* (Wang & Pan, 1998).

Whytockia hekouensis Y. Z. Wang var. **minor** (W. W. Smith) Y. Z. Wang, comb. nov. Basionym: *Whytockia chiritiflora* (Oliver) W. W. Smith var. *minor* W. W. Smith, Trans. Bot. Soc. Edinburgh 27: 338. 1919. *Whytockia tsiangiana* (H. Handel-Mazzetti) A. Weber var. *minor* (W. W. Smith) A. Weber, Notes Roy. Bot. Gard. Edinburgh 40: 365. 1982. TYPE: China. Yunnan: Yuanyang, Feng Chunling (Feng Chen Lin), in mountain forest, 7000 ft. alt., *A. Henry 11232* (holotype, E; isotype, K).

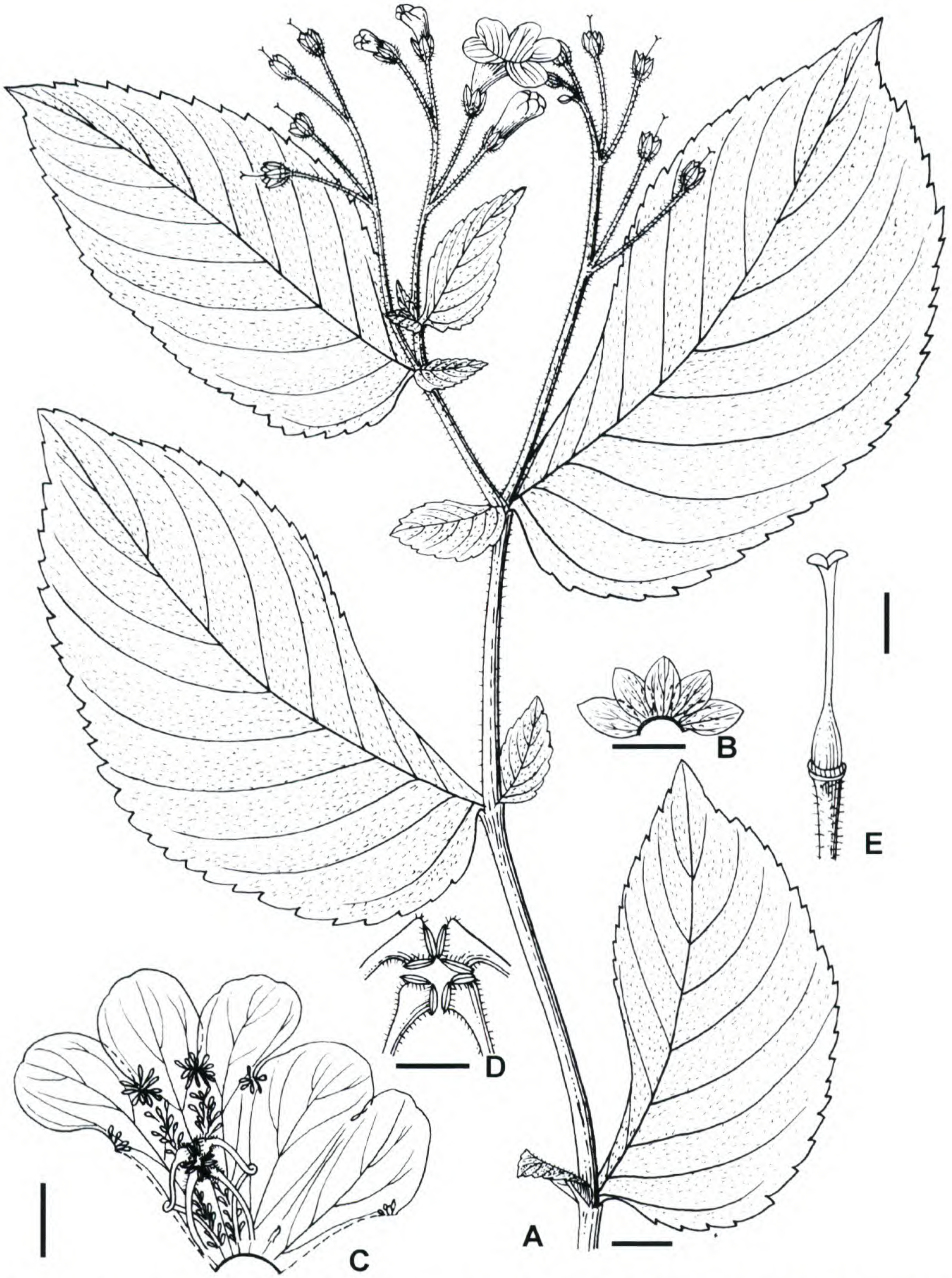

Figure 1. Diagrammatic illustrations of the holotype of *Whytockia wilsonii* (*E. H. Wilson 3292*, BM). —A. Plant with flowers, scale bar = 10 mm. —B. Opened calyx taking view from abaxial side, scale bar = 4 mm. —C. Corolla opened to reveal two internal rows of clavate hairs under and between lobes of the lower lip, scale bar = 4 mm. —D. Anthers, scale bar = 2 mm. —E. Pistil, showing longer styles 2–2.5 times as long as ovary, and two stigmas connate at their base, scale bar = 2 mm.

Whytockia hekouensis var. *minor* differs from variety *hekouensis* in its calyx lobe narrowly ovate, apex ascending-spreading; flower pedicel not incrassate on upper portion after anthesis.

Whytockia wilsonii and *W. hekouensis* var. *minor* were previously treated as varieties within *W. tsiangiana* (Weber, 1982). The former was described as a new variety for *W. tsiangiana*, while the latter was transferred from *W. chiritiflora* to *W. tsiangiana* (Weber, 1982). The species *W. tsiangiana* is characterized by its small, white corolla (8–12 mm long), its shorter style equal to the ovary or less than 1.5 times as long as the ovary, and its wholly connate stigma. Four other species, *W. bijieensis*, *W. wilsonii*, *W. chiritiflora*, and *W. hekouensis*, have large, red corollas (1.5–2 cm long), longer styles 2–2.5 times as long as ovary, and 2 stigmas free or connate only at their base or in their lower half. Among the four species, the 5-lobed calyx united in a tube to the mid-point of the calyx makes *W. chiritiflora* and *W. hekouensis* cluster together, while *W. wilsonii* is closely related to *W. bijieensis* in five sepals that are free or connate at base, and two stigmas that are free or only connate at base. In addition to the above morphological characters, the karyotype of *W. tsiangiana*, i.e., $2n = 18 = 4m + 8sm\ (2sat.) + 6st$, demonstrates a high degree of asymmetry that is remarkably distinctive from those of other species above. *Whytockia wilsonii* and *W. bijieensis* have closely similar karyotypes, for the two species have similar frequencies of median and submedian chromosomes and lack a subterminal chromosome, i.e., $2n = 18 = 2M + 8m\ (1sat.) + 8sm\ (2sat.)$ in *W. wilsonii* and $2n = 18 = 2M + 8m + 8sm\ (1sat.)$ in *W. bijieensis* (Wang et al., 1998). Moreover, *W. tsiangiana* is widely distributed from eastern Guizhou Province to central China, i.e., Hunan, western Hubei, and northern Guangxi Provinces. In contrast, *W. wilsonii* is limited to southern Sichuan Province adjacent to the distributional area of *W. bijieensis* in western Guizhou and northeastern Yunnan Provinces (Wang & Li, 1997). *Whytockia chiritiflora* and *W. hekouensis*, two species standing sharply apart from the rest of *Whytockia* in their 5-lobed calyx united in a tube to the mid-point of the calyx, are restricted to separate localities in southeastern Yunnan Province (Wang, 1995). The four species, i.e., *W. bijieensis*, *W. wilsonii*, *W. chiritiflora*, and *W. hekouensis*, are located in the area where the plants of Gesneriaceae are most diverse in the world. A diagnostic key for these five species (including varieties) is provided below.

Key to the *Whytockia* Species and Varieties Discussed Above

1a. Corolla white, 0.8–1.2 cm long; style 0.6–0.8 mm long, equal to ovary or less than 1.5 times as long as ovary; stigma wholly connate, elliptic-disciform . . . . . *W. tsiangiana*
1b. Corolla red or reddish, 1.5–2 cm long; style 4–6 mm long, 2–2.5 times as long as ovary; two stigmas free or connate at base or in lower half.
2a. Five-lobed calyx united in a tube to the mid-point of calyx.
3a. Two stigmas free; fruit a capsule, bivalvate dehiscent . . . . . *W. chiritiflora*
3b. Two stigmas connate in lower half; fruit a capsule, irregularly dehiscent . . *W. hekouensis*
4a. Calyx lobes widely ovate or ovate-triangular, apically reflexed; pedicel incrassate on upper portion after anthesis . . . . . *W. hekouensis* var. *hekouensis*
4b. Calyx lobes narrowly ovate, apically ascendingly spreading; pedicel not incrassate on upper portion after anthesis . . . . . *W. hekouensis* var. *minor*
2b. Calyx with 5 sepals, free or connate at base.
5a. Larger leaf blade of unequal leaf pair narrowly ovate-oblong, margins irregularly repand-serrate and glandular-serrate, these serrations 1–1.5 mm long, base auriculate or rounded on wide side; the two stigmas free; seed testa reticulate . . . . . *W. bijieensis*
5b. Larger leaf blade of unequal leaf pair widely obovate or broadly ovate-oblong, margins serrate-dentate, these teeth 1.5–3 mm long, base widely cuneate or rounded on wide side; the two stigmas connate at base; seed testa obliquely striate . . . . . *W. wilsonii*

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Delphinium hillcoatiae var. *pilocarpum* (Ranunculaceae), a New Variety from Xizang, China

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ABSTRACT. *Delphinium hillcoatiae* var. *pilocarpum* Q. E. Yang & Y. Luo (Ranunculaceae) is described as a new variety from Xizang, China. It differs from the typical variety by having densely puberulent ovaries.

Key words: China, *Delphinium*, Ranunculaceae.

In the course of examining specimens of Ranunculaceae at Kew in 2002, four collections of the genus *Delphinium* L. from the neighborhood of Lhasa, the capital city of Xizang, China, caught our attention. At first glance all four collections, *F. Spencer Chapman 136, 943, J. F. Duthie s.n.*, and *L. A. Waddell s.n.*, show no essential difference in appearance from *D. hillcoatiae* Munz, a species also described from this region. However, upon careful examination we found that one of the collections, *Chapman 943*, has glabrous ovaries, while the remaining three all have densely puberulent ovaries. In the protologue, Munz (1968) described his species as having glabrous carpels. This has been confirmed by our examination of the holotype of Munz's species, *Ludlow & Sherriff 2424*, and the paratype, *Kingdon Ward 12370*, both deposited at BM. These two collections have totally glabrous ovaries indeed. One gathering at PE, *Qinghai-Xizang Exped. 7938*, which was made from Qüxü County very near Lhasa and named as *D. hillcoatiae*, also has densely puberulent ovaries. The descriptions of *D. hillcoatiae* in the *Flora Reipublicae Popularis Sinicae* (Wang, 1979), *Flora Xizangica* (Wang, 1985), and *Flora of China* (Wang & Warnock, 2001) may all have been mainly based on this collection because the ovaries were described as puberulent in these works.

Delphinium hillcoatiae is only known from the Lhasa region, Xizang, China. This species is distinguished by its woody root, leaves 3-partite within 1 cm from the base, stem, inflorescence rachis, and pedicels all densely spreading glandular puberulent, 4- to 20-flowered terminal raceme, and staminodes and petals black-brown. Based on these characters it should be a member of *D.* subg. *Delphinastrum* (DC.) Petermann sect. *Elatopsis* Huth, but we cannot yet find with certainty its closest ally in the Chinese species of *Delphinium*.

As the specimen at PE cited above as well as the three specimens at Kew, all with densely puberulent ovaries, show no other difference from *Delphinium hillcoatiae* and occur in nearly the same region as the species, it seems reasonable to treat them as a new variety.

Delphinium hillcoatiae Munz var. **pilocarpum** Q. E. Yang & Y. Luo, var. nov. TYPE: China. Xizang: Qüxü County, shady places, 3600 m, 25 Sep. 1975 (fl), *Qinghai-Xizang Exped. 7938* (holotype, PE; isotype, PE).

A typo ovariis dense puberulis differt.

This variety differs from *Delphinium hillcoatiae* var. *hillcoatiae* by its densely puberulent ovaries. In the typical variety, the ovaries are totally glabrous.

The two varieties are only known from the Lhasa region and its neighborhood, Xizang, China. According to the collectors' note, the typical variety grows on open dry stony hillside, whereas the variety *pilocarpum* grows in shady places.

Paratypes. CHINA. **Xizang:** Lhasa, 18 Sep. 1904, *L. A. Waddell s.n.* (K), May–July 1947, *J. F. Duthie s.n.* (K); Cheesul (= Qüxü ?), 11,500 ft., 21 Aug. 1936, *F. Spencer Chapman 136* (K).

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